Compressed Air Magazine

JUNE 1943

PHOTO SIGNAL CORPS, U.S. ARMY.

ALCAN HIGHWAY

Bit of scenic grandeur on the new strategic road to Alaska.

VOLUME 48 • NUMBER 6

NEW YORK • LONDON

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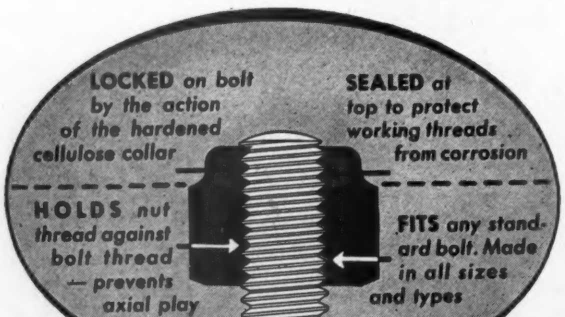

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ON THE COVER

ALTHOUGH it was built to further the war effort, the Alcan Highway will prove to be a valuable national asset in future years. It will open to motorists a vast, hitherto inaccessible area that has much to offer the sportsman and sightseer. Our cover picture shows a typical stretch along one of the higher sections of the road, with Rocky Mountain peaks in the background.

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IN THIS ISSUE

EXCEPTING those who constructed it, no one is better qualified to write about the Alcan Highway than Harold W. Richardson, author of the article that begins on page 7047. He was the first outsider to travel the road from end to end, a journey to which he devoted several weeks. The picture shows him at Mile Post 0 on the northern end of the highway near Slana, Alaska. Mr. Richardson is

western editor of *Engineering News-Record*, with which publication he has been affiliated since receiving a civil-engineering degree from the University of Colorado some twenty years ago. He is coauthor with Robert S. Mayo of the book *Practical Tunnel Driving*, which was written in 1940. He is now covering the Alcan Highway a second time and has promised us another article.

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SOME of the many innovations included in the new power house of C. F. Braun & Co. are described in our second article. The author, Coles B. Bason, is a sales engineer in Los Angeles.

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IN THE first of two short articles Henry W. Young of Portland, Ore., describes the protective metal-coating of timber piling designed for use in salt water, and in the second one Fremont Kutnewsky of Albuquerque, N. Mex., gives some interesting facts about pumice.

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VOLUME 48 **June, 1943** NUMBER 6

C. H. VIVIAN, *Editor*
A. M. HOFFMANN, *Assistant Editor*
J. F. KENNEY, *Business Manager*
J. W. YOUNG, *Director of Advertising*
W. M. HACKENBURG, *Advertising Manager*
D. Y. MARSHALL, *Europe*, 243 Upper Thames St., London, E.C.4.
F. A. MCLEAN, *Canada*, New Birks Building., Montreal, Quebec.

EDITORIAL CONTENTS

ADVERTISING INDEX

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Building the Alcan — America's Glory Roa

Harold W. Richardson

CRITICS and skeptics said it couldn't be done. They doubted that a road could be built across the unmapped, uncharted, and unknown wilderness of northern British Columbia, the Yukon, and eastern Alaska. They said at least it could never be built in time to be of service in this war. Lastly, they declared it couldn't possibly be pushed through the route selected because of impassable muskeg. But they simply overlooked the ability and resourcefulness of the U. S. Army Engineers, American and Canadian contractors and engineers of the U. S. Public Roads Administration, and the stamina of American construction equipment.

Today the Alcan Highway stands as a mute answer to all the criticism and abuse heaped upon the project in its early stages. For those intrepid engineers and contractors flung a double-lane, gravel-surfaced military route 1,800 miles long, including branches and connections, across that Northwest wilderness, and did it in the incredibly short time of one Arctic construction season. Their triumph ranks as the greatest construction achievement since the Panama Canal. They threw more than 200 timber bridges across raging mountain torrents and broad placid rivers to carry the road across every stream on a temporary structure; they placed some 6,000 native-pole culverts at spots requiring local drainage. Most of this was done between July 1, when army troops and contractor forces got rolling full speed, and November 20, when the road was officially dedicated and opened to through military traffic. To top off a good job, they completed winter housing along the route last fall to accommodate the troops and contractors that operated and maintained the road all through the bitter cold months.

An international highway to Alaska has been talked about for 30 years. Presidents Hoover and Roosevelt both appointed engineering commissions to study the possibilities of such a project. Numerous engineering reports were submitted, but no action was taken until Pearl Harbor jolted the nation into realization of the vulnerability and inaccessibility of Alaska. Overnight the territory became a vital theater of war in the Pacific area, reached only by sea and by air. The sea route was menaced by enemy action early in the war; the air route was inadequate for the transportation of desperately needed military supplies and personnel. It was to provide another means of reaching this important area, a

1,800 MILES IN LESS THAN FIVE MONTHS

In normal times it would have taken years to carve this highway through the Northland. Under pressure of wartime needs it was done in less than five months, despite subzero temperatures and countless obstacles. In the vanguard of mechanical equipment that made this possible were bulldozers (bottom center) that smashed through forests, toppling over trees to start the trail road over which machinery could be moved to more advanced locations. A handclasp of the grinning drivers of the two lead bulldozers (lower left), one from the Yukon and the other from the Alaskan end, marked the closing of the final construction gap. They met near Beaver Creek, Yukon Territory, on October 25, 1942. A section of the completed highway is seen at the left, center. In the distance is the main range of the Rocky Mountains, where the road reaches its highest elevation, 4,212 feet above sea level. The other picture shows the crossing of the Muskwa River, south of Fort Nelson, B.C. Bridges such as this one were probably carried away by running ice this spring and will be replaced by temporary structures pending the erection of permanent steel bridges.

Photo, Signal Corps, U.S. Army

USES OF COMPRESSED AIR

To speed construction work, the route was laid out to avoid rocky terrain wherever possible, and the amount of drilling and blasting required was therefore comparatively light. Occasional stretches called for rock excavation, however, as two of these pictures attest. At the right is a Mobil-Air compressor supplying air to a drilling crew, and the view above shows soldiers using FM-2 wagon drills to put in toe holes. Other air-powered equipment on the job included woodborers, spike drivers, and backfill tampers. A machine of the last-named type is illustrated in the circle. It is consolidating earth around a wood-stave culvert.

Photo, Signal Corps, U.S. Army

protected overland route, that the Alcan Highway was started in such a rush in the spring of 1942 and carried forward to passable completion last fall.

All the reports submitted prior to the war favored one of two routes, both starting at Prince George, B. C., and running north up the trough between the Rocky Mountains and the Coast Range. The U. S. Army Air Corps, working jointly with the Canadian army in 1941, established a series of airports across Canada and in eastern Alaska for the defense of both countries. This air route starts at Edmonton and follows along the east side of the Rocky Mountains almost to the Yukon border before turning west to cross the mountains. The Alcan Highway was located to serve these airports in the wilderness for two reasons: First, to provide emergency ground access to them, and, second, to permit trucking gasoline to them for refueling the Air Ferry Command and military planes, thereby releasing valuable air cargo space being used for the transportation of gas. These facts were brought out in answer to criticism stemming out of Senate hearings last June, but the tirade against the Army by proponents of the more western route for the highway continued for a long time. Perhaps some day a road, or perhaps a railway will be built up the trough to the west. The Army Engineers have completed the survey for a railroad, but for the present the plans have been shelved.

The Alcan Highway starts at Dawson Creek, B. C., 500 miles northwest of Edmonton, Alta., at the end of a branch line of the Northern Alberta Railway. There is no good road connection between the existing Canadian network of highways and the Alcan, only a poor, ungraded country road that is impassable most of the year. At present the main access to the Alcan is by rail. From Dawson Creek, a frontier village afflicted with growing pains, the latter highway follows an old provincial road as far as Fort St. John, 60 miles away, and then plunges into the wilderness, running northward for 265 miles to the trading post of Fort Nelson at the junction of the Muskwa and Fort Nelson rivers. Between Dawson Creek and Fort St. John the road crosses the Peace River, nearly 2,000 feet wide. Around Dawson Creek is the Peace River Block, a surprisingly fertile area of farmland, but civilization fades away at Fort St. John.

At Fort Nelson the route turns abruptly west, following the Muskwa and Tetsa river valleys to Summit Lake Pass, where the main range of the Rocky Mountains is crossed at Elevation 4212, the highest point on the Alcan. From there it extends to the Liard River by way of one and then another river valley through the mountains, and next follows this broad stream for 200 miles westward into southern Yukon Territory west of Watson Lake. The road continues westward up the Rancheria and down the Swift and Morley river valleys to the Teslin Lake country, where it turns northwest toward Whitehorse, principal city of the Yukon.

Whitehorse, at the end of the narrow-gauge White Pass & Yukon Route Railway, is 111 miles from tidewater at Skagway and the main access point to the central section of the Alcan Highway. From Whitehorse the new road heads off to the northwest through the western Yukon via the Takhini, Dezadeash, Kluane and White River valleys to the Alaska border. There the route picks up the headwaters of the Tanana River and follows this valley all the way to Big Delta and thence to Fairbanks via the old Richardson Highway built some years ago from Valdez, on the seacoast, to Fairbanks, in the interior. A branch of the Alcan takes off from the main route at the junction of the Tok and Tanana rivers and follows up the Tok and down the Slana and Copper rivers to meet the Richardson Highway again at Gulkana, only 137 miles from the sea at Valdez.

The Alcan Highway taps an empire rich in natural resources awaiting transportation facilities for development. Of course it is primarily a military road today, civilian travel is excluded for the

duration, but it offers great peacetime commercial and tourist possibilities. In the territory traversed are timber, coal, oil, gold, copper, antimony, radium, quicksilver, tungsten and other resources. From a tourist and vacation standpoint, the country offers every delight. The highway winds through deep forests, crosses streams, and skirts lakes full of fish, cuts through scenic mountain ranges and some of the best big-game hunting grounds on the continent. Both Canada and the United States have already set aside a strip of land on each side of the route to control its development.

While only one-fifth of the present Alcan Highway lies in Alaska, it is no doubt the forerunner of a transportation system in the territory that will open up the region to its full potentialities. Alaska covers 583,000 square miles, more than twice the area of Texas, and had a prewar population of only 60,000. Father Hubbard, noted authority on the country, declares that it is capable of supporting a population of 15,000,000, which indicates the possibilities of that long-neglected possession.

Construction of the Alcan Highway is directly under the Corps of Engineers of the U. S. Army. Seven regiments of engineer troops were sent up there to build a pioneer road under these instructions: "Build a pioneer route with all speed possible within the physical capacity of the troops. The route is to be built to a standard merely sufficient to sustain the troops." Except for a few simple specifications, those were the only instructions given the roadbuilders.

The main route, or final-type highway as it is called by the Army, was to be constructed by the U. S. Public Roads Administration under Army direction with contractors. The Army notified PRA to follow "Specifications and standards for national parks and forests highways as issued by PRA in 1941." This is a very high-type road, often spoken of as a 70-mile-per-hour highway. These specifications were modified slightly later, but in general they called for a 60-foot graded subbase covered with 12 inches of selected material topped with an 8-inch course of 2-inch gravel and a 4-inch course of 1-inch gravel 36 feet wide. Eventually a 2-inch bituminous paving will be placed and all bridges will be permanent structures designed by PRA. The Army troops were to locate the pioneer route with its use as the final-type road in mind, except where the PRA found better alignments. All engineering on the main highway was to be done by PRA, all construction under contract.

The engineer troops sent to the project included the 18th and 35th combat regiments and the 93rd, 95th, 97th, 340th and 341st general service regiments. Three of the seven—93rd, 95th and 97th—were colored troops commanded by white officers. Several companies of auxiliary troops such as ponton, truck, and ordnance outfits augmented the roadbuilding regiments. This entire list was recently cited for meritorious conduct by the War Department as follows: "Commencing with the spring thaw and continuing on through the summer floods, the troops overcame the difficulties imposed by mountainous terrain, deep muskeg, torrential streams, heavy forests, and an ever-lengthening supply line. By virtue of remarkable engineering ability, ingenious improvisations and unsurpassed devotion to duty, the units assigned to the highway construction completed their mission in one short working season and thereby opened a supply road to Alaska that is of inestimable strategic value."

The 35th was the first regiment to reach the scene, along with some 30 carloads of equipment, and detrained at Dawson Creek March 12, 1942, with the thermometer at 35° below zero Fahrenheit. To spread the troops over more line so as to attack the road at another point, it was important to get them inland as far as Fort Nelson, 325 miles away, before the spring thaw set in, as the only passable route was over frozen muskeg. It was a race against time, across the Peace River ic and over the frozen swamp. Temperatures dropped to 47° below zero. Wrecks were frequent and messy. Tractor drivers riding on unprotected seats suffered from the bitter cold as they walked their big rigs over the frozen trail at the rate of 3 miles an hour. Supply lines broke down, meals became more and more infrequent. Yet, despite all hazards and difficulties, the entire regiment pulled into Fort Nelson just a few days before a Chinook wind broke up the trail, with all equipment intact, without loss of a single life, and with four months' rations on hand. This achievement made possible the completion of the highway last year, for the pioneer road never reached Fort Nelson until August 24, and by that time the battling 35th was nearly 300 miles to the west.

The 341st and 95th regiments came into Dawson Creek a few weeks later and worked on the stretch to Fort Nelson. Meanwhile, the 18th, 93rd, and 340th landed at Skagway en route to the highway at Whitehorse. The first proceeded west from Whitehorse and the two others east, the 340th jumping ahead overland (in good weather) to Nisutlin Bay at Lake Teslin. The 97th regiment went in through Valdez and drove the trail road from Gulkana eastward into the Yukon. The gap between Whitehorse and Fort Nelson was closed September 24 when the 340th met the 35th east of Watson Lake.

On October 25, late in the dusk of an Arctic afternoon, the lead bulldozer of the 97th, piloted by Corpl. Refines Sims, Jr., of Philadelphia, Pa., met Pvt. Alfred Jalufka, of Kennedy, Tex., pushing the lead bulldozer of the 18th regiment westward from Whitehorse. In a sudden, dramatic climax near the shore of Beaver Creek, 30 miles east of the Alaska border, the blazing of the pioneer route through the wilderness was completed. The last frontier of the Northwest was rolled back at last; an overland route from Canada to Alaska had been smashed through in record time against all odds and despite every difficulty.

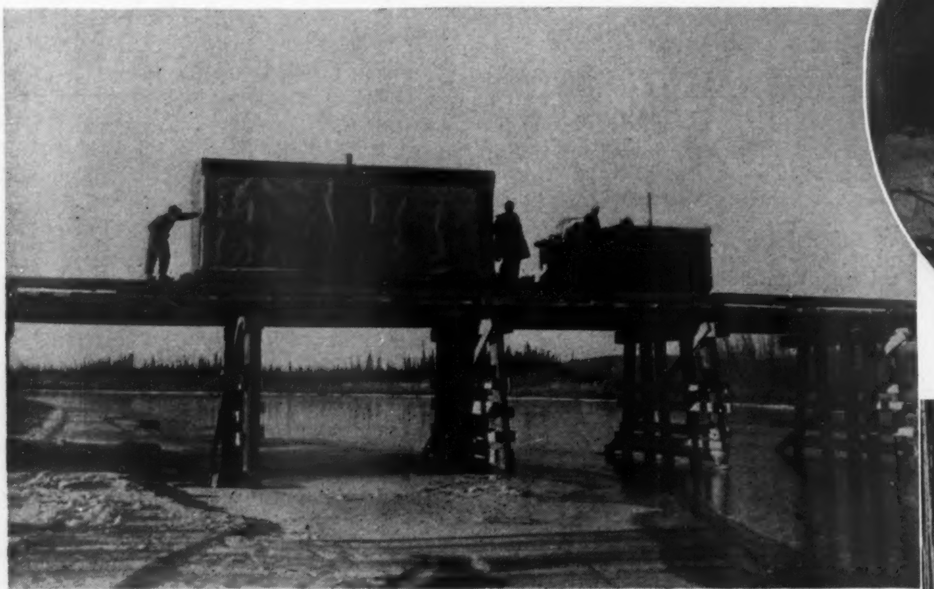
The Public Roads Administration established a main office at Seattle, Wash.,

A PONTON FERRY

Fording of the larger streams before bridges became available was accomplished with various kinds of ferries. Shown here is a craft made by decking over half a dozen pontons that are lashed together and by equipping it with an outboard propulsion motor.

CAMP SCENES

The Army forces were quartered in tent camps, one of which is seen in the bottom picture. The contractors also started out using tents, but most of them soon tired having to take them down and to repitch them after each frequent move. To eliminate this work they built structures on skids. These were drawn by tractors (below). All the camps lacked the comforts of home. At the right is a bewhiskered workman washing out his "woolies" in water heated in an abandoned oil drum.



Photo, Caterpillar Tractor Co., from U.S. Army

and principal field offices at Fort St. John, Whitehorse, and at Gakona, Alaska, near Gulkana. Four managing contractors were selected by PRA on a fixed-fee basis to direct the construction of the final-type road. These were: Okes Construction Company, St. Paul, Minn., part of the British Columbia section; R. Melville Smith Company, Toronto, Ont., remainder of British Columbia; Dowell Construction Company, Seattle, Wash., Yukon section; and a combination of C. F. Lytle Company, Sioux City, and Ralph Green Construction Company, of Des Moines, Iowa, the entire Alaska section. E. W. Elliott Company, Seattle, was given the job of transporting all men, supplies, and equipment for PRA and the contractors from the United States to the project.

The four managing contractors selected 54 individual firms, thirteen of them Canadian, for the construction work, also on a fixed-fee basis. Only the Canadian concerns could use Canadian labor, all workmen for the American contractors came from the United States. The project was approached through the three main gateways: Dawson Creek, Whitehorse (via Skagway), and Gulkana (via Valdez). Some of the workers were flown in, but most of them went by rail to Dawson Creek or by boat to Skagway or Valdez. Each of the individual contracting firms was a specialist and was assigned to a definite function, such as bridge building, grading, or gravel surfacing. They were spread over the job as much as possible, using the pioneer route as access, and filtered in from the last of April to the last of June.

The project started according to the plans outlined, with the Army troops smashing ahead with the pioneer road and the contractors, under the direction of PRA, following along behind on the final-type highway. This procedure was continued until early in August. Then the Army realized that the objective of getting a military route to Alaska last winter would not be realized, for the specifications under which the contractors were working were too exacting for fast construction, and that only a rough trail road would be finished before winter.

Therefore, on August 8, the plans were suddenly changed. The Army asked PRA to stop operations on the main highway and to switch the contractors to the pioneer route so as to help the Army get that rough trail completed, graded, and gravel surfaced into a passable road for winter trucking. The highway as finished and dedicated last fall is the improved pioneer route, and such a fine job was done that much of it can be salvaged as the final road. Of course, in some places relocation is desirable, for a more leisurely study of the route has revealed better local alignments that were overlooked in the rush to smash it through last year. However, in general, the first location was a splendid piece of work considering the speed and difficulties under which it was done.

Without taking away any glory from the troops and the contractors' workmen, good old American construction equipment made the Alcan possible. Never before has roadbuilding machinery shown up to better advantage. Some of it new, much of it old, it stood up beyond all expectations on a grueling job far from sources of spare parts and supplies, with repair facilities limited, and under green operators in many cases. The Army was able to take along all new equipment, except 100 trucks for the 97th regiment. This was a great advantage, for most of the operators had to be broken in on the spot after the job was started. Typical of the equipment that accompanied each regiment is the following of the 35th. While it varied somewhat with the different ones, and was augmented in cases as the work progressed, it indicates the

amount and the type used by the Army:

20 heavy diesel tractors, bulldozers
24 light gas tractors, bulldozers
6 pulled graders
3 patrol graders
6 rooter plows
6 twelve-yard carrying scrapers
93 dump trucks
1 six-ton prime mover truck
16 cargo trucks
25 jeeps
10 command cars
1 sedan
12 pickup trucks
1 truck crane
2 shovels, ¾-yard
25 portable light plants
1 small concrete mixer
1 portable air compressor, 315 cfm.
8 small air compressors
6 plows
24 gas-driven saws
2 portable electric welding outfits
8 drop pile hammers
Pontons and equipment

All equipment used by the contractors was secondhand, some of it very old. Each one brought along some, paid for on a rental basis, for his own particular type of work, but most of it was supplied by PRA. This was all old CCC equipment that had been in service for several years. It was supposed to have been overhauled and put into first-class shape, but actually much of it arrived on the job in poor condition. This also applied to the contractors' equipment. In addition to this handicap, there was some delay in transporting it to the job, especially to Alaska and the Yukon, because of shipping difficulties. At no time did the contractors have sufficient machinery on hand in working order for most efficient operation.

Compressed air played a small but important part in 1942; it will be needed much more this coming season on the permanent bridges, culverts, and the main highway. The principal use of air tools and equipment last year was in building the temporary bridges, where air drills bored the bolt and drift-pin holes, speeding up the work considerably. There was some rock excavation, which of course required pneumatic drills; but, in the rush to get the road through, such work was avoided wherever possible. The biggest rock job was a 3½-mile cut at the foot of a rocky cliff along Muncho Lake in the Canadian Rockies. On the few stretches of main highway completed before the contractors went over to the pioneer route, all the culverts were backfilled with material tamped with air-operated hammers. This year, thousands of permanent culverts will be placed; steel and creosoted timber bridges will be constructed; and there will be a lot of rock work on the main route, all necessitating pneumatic equipment. In addition, the managing contractors will have complete machine shops fitted with air tools.

Keeping the roadbuilding machinery rolling in 1942 was a problem in the face of a lack of repair parts and facilities. The equipment was worked day and night, seven days a week. Rough going, long hours, and green operators took their toll. Not until October did spare parts, tires, and wire rope begin to arrive in any quantity. Repair parts had to be ordered over the congested Signal Corps radio system; priority arguments consumed valuable time; and more time was lost because of shipping difficulties. When a piece of machinery broke down for want of a major repair part it often took weeks to get the rig going again.

Each managing contractor set up a central repair shop, crude at first, but improving as machine tools dribbled into the project. Also, each individual contractor and army unit established field repair stations, usually in tents. But the bulk of this work was done right out on the highway with portable welding and repair outfits. Because spare parts were mighty scarce, "strip tease" became the usual procedure—a unit of equipment was sacrificed for the parts it could supply other units. Stripped skeletons dotted the road from end to end by the close of the season.

Actual construction of the road was fairly easy, for it was simple in design. Locating it; keeping the supply lines open; establishing, moving, and setting up camps; fighting mud, mosquitoes and black flies; battling flood waters; and keeping the equipment in repair were all more difficult jobs.

The pioneer route was located by the Army and the final road by PRA engineers. As the highway was to serve the existing airports, the general route was automatically set to tap these fields. A rough location was first established by reconnaissance by air and by exploring field parties. After that was determined the route was mapped by aerial photography. Final location of the pioneer road was made by stereoscopic examina-

CROSSING FROZEN GROUND

In western Yukon, where frost stays in the subsurface soil the year round, it was found that excavating to obtain a firm road foundation was unsatisfactory. The alternate procedure that was adopted consisted of using trees felled on the right-of-way to form a mat on top of the moss and leaves, as shown above. This insulation blanket kept the ground frozen and was covered with gravel 4½ feet deep. The stretch seen at the right was surfaced with gravel hauled 18 miles from the bed of the Donjek River, this being the only unfrozen fill material in the region.

BUILDING UPON SAND

One of the location problems was to carry the road over the numerous dry washes or delta fans emerging from the side canyons of the Canadian Rockies. The white streak in the aerial picture below indicates the route of the highway across one of these detrital deposits. Rather than spend the time required for channeling to control the water, the engineers elected to construct the roadway across these dry washes on a light fill, as shown at the right. The fill will be replaced when and if it is washed out.

tion of the aerial photographs, which brought the land into 3-dimensional relief. The route was next plotted with red ink on the photographs, which were then given to the locating parties on the ground. Most of the time the latter could follow the designated line exactly, but sometimes hidden, adverse ground conditions necessitated minor changes in alignment.

In plotting the road the engineers soon learned that various types of timber, discernible in the aerial photographs, indicated different kinds of ground. Certain trees grow in muskeg land, therefore forests of such trees were by-passed. Heavy clearing was also avoided, if at all possible, and rock outcrops and ledges were by-passed if there was any chance of doing so. In the early days heavy rains plagued the project, creating many local wet spots that were avoided. This resulted in a twisting, sharply curved route in some places.

The ground locating parties, working from the photographs, blazed the center line. Following close behind was the lead bulldozer, clearing out a swath along that line. Next came two to four more bulldozers knocking down the trees and pushing the debris off to the side. Little attempt was made to burn the cleared trees and brush. Because the trees in the frozen Northland have no deep tap roots the big bulldozers were able to knock them down and uproot them with ease—it was not necessary to cut even the largest of them. This procedure greatly speeded up the job of clearing.

The lead bulldozers did very little grading, just enough for the fuel-supply trucks. Often, however, the ground was so bad that drums of diesel fuel and lubricating oil were dragged to the head end on sleds or wagons hauled by tractors. Subsequent crews did what grading was necessary on the trail route, built culverts and bridges, and maintained the camps. Some regiments did a lot of gravel surfacing as they went along, others did none.

Muskeg was supposed to be the bugaboo of the job. True, much of it was encountered, but in most cases the locators were able to duck around the bogs. Where muskeg had to be crossed—an aggregate of 16 miles for the whole project—the corduroy method was used. From one to six or seven layers of poles and logs were laid on the soft ground as a support for the fill.

The Alcan Highway traverses many types of ground, but none more baffling at the start than the perpetually frozen soil of western Yukon and in some spots of Alaska. There, permanent frost lies from 6 to 12 inches below the surface. Orthodox roadbuilding methods were tried at first; the top mat of leaves, moss, and grass was removed prior to grading. However, as soon as this mat was stripped, the frozen ground immediately below started to thaw, for the cover of vegetation acted as insulation. As the ground thawed it got muddy, and when the mud was scraped off more ground thawed out, creating more mud. Obviously, this was not the way to construct a highway in frozen country.

A new procedure was adopted, ignoring roadbuilding principles—the removal of all organic matter from the base of the subgrade. Instead of stripping the insulating mat, the engineers left it in place and piled all the trees and brush cleared from the right-of-way on it to protect it and to add more insulation. The theory of this method was that if the ground could be kept frozen under any and all temperature conditions it would be an excellent foundation for the highway.

An existing country road between Dawson Creek and Fort St. John was relocated and constructed according to PRA standards for the final highway by the Canadian group of contractors. The Army also turned the entire job of building the section between Big Delta and the junction of the Tok and Tanana rivers in Alaska over to the contractors. This was started as a final-type road, but speed requirements relaxed the standards somewhat before the stretch was finished.

Gravel for surfacing and for main-highway construction was plentiful in most places because the country has been visited by glaciers many times in the past. While the main road was supposed to be built with graded gravel, a shortage of crushing and screening equipment actually required the use of selected pit-run material in most cases. All the surfacing for the pioneer route was pit-run material.

All the temporary bridges were constructed of timber cut at or near the site. Sometimes, before sawmills and pile drivers reached the scene of operations, the Army built them with hand tools only. In such cases the structures were simply

framed bents set on mudsills, or rock-filled cribs, carrying log stringers and pole decks. As soon as sawed timber was available, they were constructed of dimension lumber and decked with planking. When the contractors moved onto the pioneer road they found that many bridges would have to be built, and they worked right with the Army forces on this phase of the job. There was one steam pile driver on the project, possibly two, and most of the pile bridges were driven with the aid of drop hammers handled by truck or crawler cranes in swinging leads.

Many ingenious uses of equipment were contrived, but none topped the 340th regiment's method of placing piles for the upper crossing of the Liard River. Those troops converted a light truck crane into a skid pile driver by mounting the truck on long skids and building A-frame leads on the front end of the skids. The rig was maneuvered by lines from the front-end winch on the truck. A drop hammer was utilized—tough on the frictions and clutches of the light crane, but the job was done in a hurry. This same outfit, lacking spikes and drift pins, helped to fabricate several early bridges with wooden dowels.

Bridge building could not keep up with roadbuilding. Before bridges were available, shallow streams were forded. Ponton companies provided ponton bridges or ferries for the larger waterways. Often, the ferries were simply half a dozen pontons lashed together, decked over, and propelled by outboard motors that usually lacked sufficient power to operate against high winds. Again, they consisted of a barge pushed by a small power boat. In some cases, cables were stretched across streams for current-operated ferries.

A few base headquarters' camps were established by means of CCC buildings shipped from the United States, prefabricated insulated panels, or lumber sawed at the site. But most of the Army and contractor field camps, which had to be moved frequently to keep up with roadbuilding, were of the mobile type, largely tents. Some of the contractors, especially the Alaska group, got tired of taking down tents, loading them into trucks for a haul up the trail, and then setting them up again, so they abandoned them for native lumber shacks mounted on log skids. When moving day came, tractors hooked onto the skids and dragged the shacks to their new location.

Most of the temporary camps were as comfortable as it is possible to make such bases in a wilderness, though the degree of comfort depended a lot upon the will of the personnel in charge. All were supervised by officers of the Sanitary Corps, who also inspected the water supply. Usually the water was safe, coming from clear mountain streams, but where pollution was suspected the supply was chlorinated by portable sterilizers. The biggest item of comfort, and the one modern note in each camp—large or small, contractor, PRA, or Army—was electric light. Current for lighting and also for portable radio sets that added so much to the workers' morale, came from portable generating sets. The radio made up in part for poor mail deliveries which were sometimes delayed as much as six weeks.

Recreation was just about nonexistent: first, because of lack of recreational facilities; and, second, because of lack of time. Everyone on the project worked, worked, and worked some more. The army troops toiled 9 to 10 hours a day, two shifts a day, seven days a week, and the contractors did two shifts of 10 or 11 hours each seven days a week. Despite the hard work and long hours soldiers and construction workers seemed to thrive on it. Sickness was rare, the health of all was excellent. The Army fed mostly field rations, which became monotonous, though the food, except in rare cases, was ample and good. The contractors and PRA fared better than the Army, probably not because of better-quality food but because of greater variety and more fresh vegetables. Refrigerator meat trucks were put into service from the base supply points just as soon as the road permitted the traffic.

Contractors paid from 96½ cents per hour for common labor to $1.60 and $1.70 for tractor drivers and scraper operators. Truck drivers got from $1.10 to $1.40. Despite the long hours per week, some of the contractors (working under approved Government regulations) did not pay overtime. It cost the workmen from $1.50 to $2.00 a day for subsistence.

Because of the great distances involved, it was a never-ending problem to keep the job in supplies and equipment. Everything had to be brought in through one of the three main bases: Dawson Creek, Skagway-Whitehorse, and Valdez-Gulkana. The Army distributed the machinery and supplies with its own trucks, while the managing contractors, who were responsible for getting them to their associated firms out on the road, used their own trucks in some cases and hired contract trucking firms in others. Contracts for oil, diesel fuel, and gasoline called for delivery at designated spots along the route, though at times it was in such poor shape during construction stages that the full contract requirements could not be met. Shipments for Whitehorse were delivered at Skagway mostly by barges towed from Seattle or Prince Rupert, B. C. Because of inadequate unloading facilities at that Alaska port, the vessels were usually anchored at high tide so they would be beached at low tide, thus permitting unloading from dry ground by cranes.

The road was operated by troops all winter, and was maintained largely by contractor forces, all quartered in semipermanent camps of the winter-housing type spotted from 45 to 90 miles apart along the route. Snow removal was no problem, for, contrary to prevailing opinion, the snow is not as heavy as in many northern states in this country.

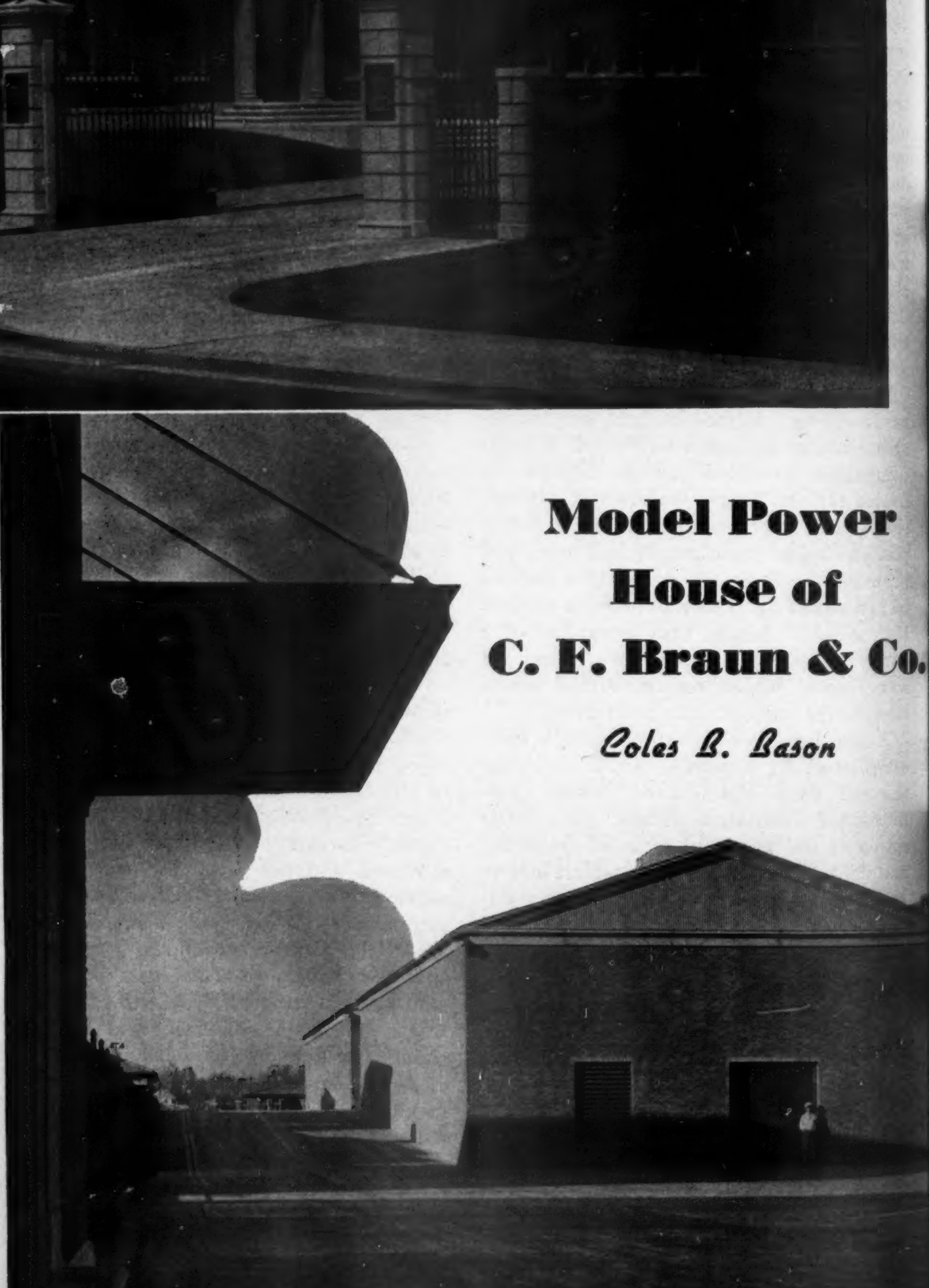
This year the Alcan construction will be turned over to the contractors. The engineer regiments that worked on the road last year have been assigned to other projects, some in the same general territory. Contractors under PRA direction (still under general supervision of the Army) will run a connecting highway from Haines, at tidewater near Skagway, to the Alcan west of Whitehorse to relieve the congestion on the narrow-gauge railroad. They will also further improve the pioneer route where it is to be salvaged, and will relocate the road to PRA final-type standards in other places. A major program this year, as has already been mentioned, will be the replacement of many of the temporary bridges with permanent structures. Some of these will be timber trusses, but most of them will be steel. Steel trusses from the abandoned Southern Pacific Railroad bridges in Shasta Dam Reservoir in California will be used for a few of the structures, and new steel is being fabricated for others. A suspension bridge is being built across the Peace River and will be completed early this summer.

The U. S. Corps of Engineers is in top charge of the entire project. Maj. Gen. Eugene Reybold is chief of engineers. At first the road was under the supervision of Brig. Gen. Wm. M. Hoge, but he was assigned to other duties when the Northwest Service Command was organized to take over all construction in that territory. Brig. Gen. James A. O'Connor is head of this command. He assigned Col. John W. Wheeler as boss of the highway, assisted by Col. E. G. Paules in the north sector and Col. R. D. Ingalls in the south sector. Several changes were made in the regimental commands during the progress of the work. Last winter the Army set-up was changed when a division office of the Corps of Engineers was established at Edmonton and six district offices were located in the field. Col. W. D. Worshom is now division engineer. The Northwest Service Command is still in general charge, but most of the officers and Army units that built the road last year have left.

For the Public Roads Administration, Thomas H. MacDonald is commissioner. J. S. Bright is district engineer in charge, assisted by Fred Capes, Frank E. Andrews, H. S. Stoddart, C. G. Polk, and L. M. Huggins as principal construction engineers. In charge for the managing contractors are: Okes Construction Company, Day Okes and William Bates; Dowell Construction Company, L. J. Dowell and Ross Woodward; Lytle & Green, Orville Crowley and C. C. Coykendall; R. Melville Smith Company, T. F. Francis. E. W. Elliott and R. B. Johnson are in charge for the Elliott Company.

Model Power House of C. F. Braun & Co.

Coles B. Bason



ONE of the most modern, efficient manufacturing plants in the United States today is that of C. F. Braun & Co., of Alhambra, Calif. Its work is concerned primarily with the engineering and construction of all types of refinery unit processes and with the construction of component parts such as heat exchangers, bubble columns, and the like. The refinery industry, as a whole, has undergone as great an expansion as any industry in the country; and because of the foresight and initiative of Carl F. Braun, president of the company, the latter was prepared for the greatly increased demands made upon manufacturers of refinery equipment.

C. F. Braun & Co. was organized in 1909 in San Francisco. The first plant supplied machinery to oil companies, shipyards, and other heavy industries. Its products included heat-exchange apparatus such as condensers, feed-water heaters, and marine-type evaporators, as

EXTERIOR VIEWS

At the top is the main entrance to the new factory, with the administration building in the background. The latter, as well as all other office structures, is air conditioned. The view at the right shows the southern end of the new power house. There are windows only in the north end of the building, making it impossible for direct sunlight to enter. The louvres at the left of the entrance door guard the air inlet of the plenum chamber that serves the power plant's air-conditioning system. Air is exhausted through "chimneys" along the ridge of the roof.

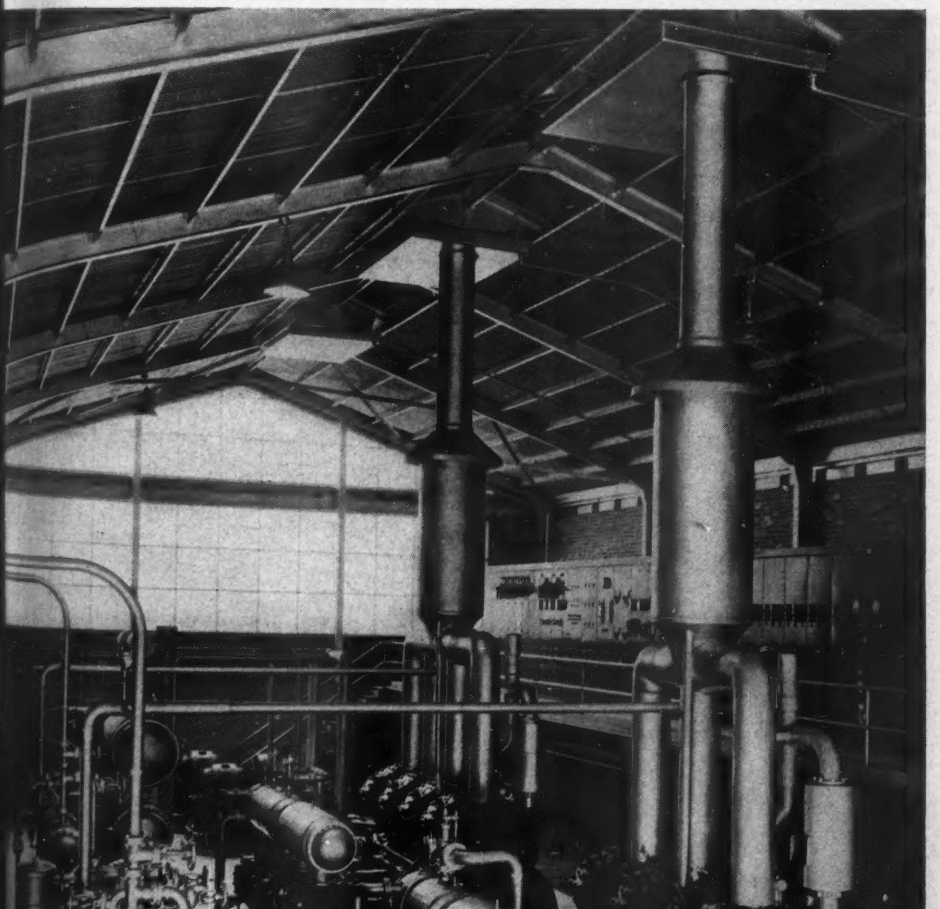
well as cooling towers, centrifugal and reciprocating pumps, strainers, filters, grease extractors, and various types of valves. In addition, the company had a redwood planing mill in Mendocino County. In 1922 the entire organization was moved to a 36-acre site in Alhambra near Los Angeles. This involved the transfer of about 50 carloads of factory and office equipment, together with nearly 100 employees and their families. It was during the company's second decade that the manufacture of pumps was discontinued in favor of apparatus and process units for the oil industry.

The present factory complements a specialized organization that designs and constructs complete plants for petroleum-refining, chemical, and other industries involving problems of heat transfer and fractionation. Contrary to the common practice of doing much of this type of work in the field, the organization shop-fabricates everything it makes and, if transportation permits, shop-assembles it. Hence the factory includes a large plate shop for fabricating, welding, X-raying, and stress-relieving, as well as a forge shop, a foundry, a pattern shop, a pipe-fabricating shop, a structural shop, a machine shop, and a wood mill. Cranes lift pieces of apparatus weighing up to 200 tons; the X-ray equipment penetrates the thickest welds; and the great stress-relieving oven accommodates, at a single heat, fractionating columns and other pressure vessels of the largest dimensions that railroads can haul.

The plant in its present state is the outgrowth of a policy of expansion that dates back to 1939. At that time, Mr. Braun started the complete modernization of the company's facilities in all departments. Various shops were rearranged, many were relocated, and the buildings housing them were extended and unitized to provide a straight-line flow in manufacturing operations and to permit of future expansion with a minimum of dislocation. As a part of the remodeling program a number of new structures were erected: two office buildings, two gate houses, and a clubhouse, and air conditioning was installed in the office buildings, old and new. In keeping with the company's policy of seeking new means of improving its products, a research laboratory was built and furnished with the latest equipment, including two 7-stage Type 2VHT turbine-driven boiler feed pumps to handle the requirements of its 600-hp. boiler furnishing steam for exchanger tests.

One of the most interesting phases of the expansion program is the new power house. The care exercised in its design, layout, and construction was so exceptional that the completed plant can be considered as a textbook example of the ideal reciprocating-compressor installation. Because of this fact a detailed description of it is included in later paragraphs. The old power house was fairly centrally located, and from that standpoint was ideal for the distribution of electric power, water, gas, and air. It was therefore logical to use the same site for the new station. In the old one the equipment was installed on two levels. Compressors, motor generator sets, switchboards, etc., were on the upper floor, while various pumps, tanks, aftercoolers, air filters, and air receivers were in the basement. In the case of the present plant, it was decided after careful consideration to place the heavy equipment such as air compressors, motor generator sets, and air-conditioning compressors on the ground floor to simplify maintenance and to reduce vibration and to install the switchboard on the upper level.

A great deal of compressed air is required during the manufacturing processes in the Braun plant, where there are in use several hundred pneumatic tools such as impact wrenches, grinders, wood borers, chippers, and sand rammers. In addition, about 120 industrial air hoists are in service. When the new power house was built it was decided to purchase new air



AIR COMPRESSORS

These two Ingersoll-Rand Type XVG gas-engine-driven compressors supply air for manifold uses in the factory. The near unit is a 6-cylinder, 225-hp. machine and the other one is an 8-cylinder, 300-hp. compressor. The exhaust from the gas engines is muffled before being conducted upward through discharge pipes that combine with the ventilating "chimneys" along the roof ridge. The flange at the top of each muffler helps to create a draft around the exhaust pipe, thus reducing radiation within the building. Drip pans near the roof are for catching rain water. The aftercoolers that serve the compressors are shown at the left.

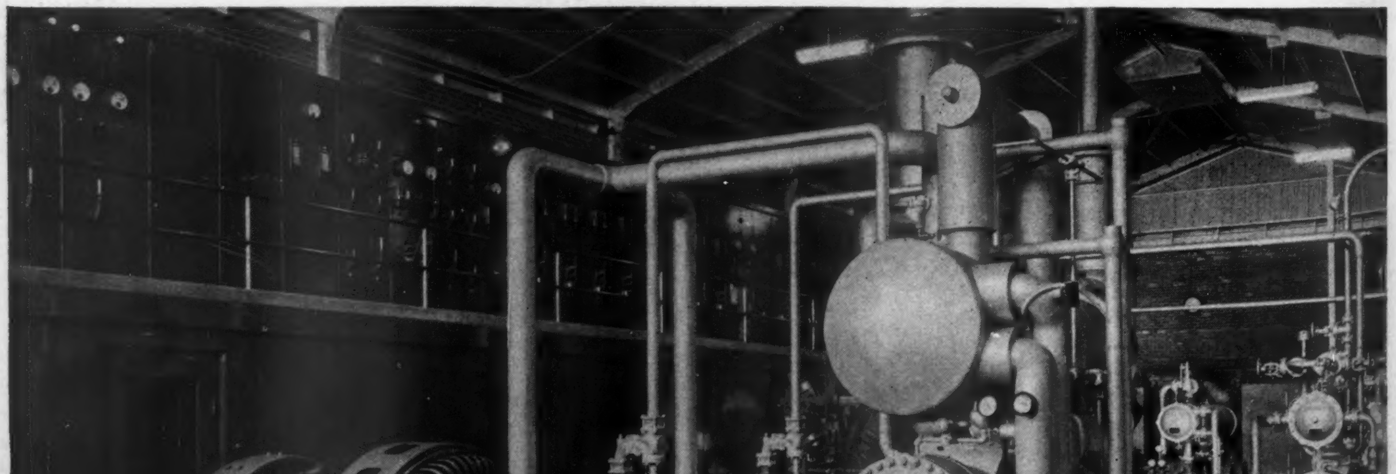
compressors to take the place of the old equipment that was both outdated and of insufficient capacity. After careful study, Braun selected two Type XVG gas-engine-driven machines, one of 300 hp. and the other of 225 hp. Provision was also made for the future installation of another 300-hp. unit. Before the old compressors could be removed, at least one of the new machines had to be set up and put in operation. In order to protect it, dustproof partitions were erected, completely isolating the old compressor location from the new power plant. Since much of the work was done during the rainy season, it was also necessary to provide temporary overhead protection against the elements.

From the foregoing it is apparent that the problem of building a new station on the site of the old one was extremely complicated. Some of the existing equipment had to be used, a good deal of new equipment had to be installed, and all the work had to be performed without shutting down any of the plant facilities. It is a tribute to those responsible for it that not a single interruption occurred and that all phases of the operations worked out as planned in the original drawings.

In the preliminary layout and design of the new power house emphasis was placed on those details that would increase operating economy and safety and that would enhance the appearance of the installation. In considering economy, one of the main problems was to arrange all equipment in such a way as to allow ample clearance for easy removal of parts requiring repair or replacement. Passageways between machinery were left wide enough so that motor-driven industrial trucks could be run into the building within reach of all equipment. The supporting members of the roof are of such design as to obviate the need of trusses or bracing, and the roof itself is composed of removable sections of galvanized iron. This permits a portable crane outside of the power house to lift and take out much of the equipment as a unit, should the occasion arise.

Thermometers and gauges are freely used to simplify the job of determining and locating leaks, bad valves on compressors or piping, and fouled exchanger and intercooler tubes. Weston dial-type thermometers are installed in pipe lines at all significant points, making it easy for operators to obtain temperatures of the air and the water flowing into and out of compressor intercoolers and aftercoolers; of water passing to and from air cylinders, oil coolers, and gas-power cylinders; of chilled water flowing to and from a Freon evaporator; and of raw water fed to the condenser of the air-conditioning system. Pressure gauges serve to indicate air pressures in the intercoolers, aftercoolers, and air receivers; there are gauges to show the pressures of the raw water delivered by the cooling-tower pumps to all the heat exchangers; and still others are on the chilled-water system of the Freon evaporator and on the suction and discharge of the Freon compressors. A manometer has been permanently installed to indicate the pressure of the fuel gas entering the mixing valves on the air compressors. A standpipe complete with glass gauges has been erected inside the power house so that the operator can make certain that there is sufficient liquid head above the inlet to the pumps.

Double filtering assures clean, cool air for the engines and the compressors. The power plant itself is completely closed; there are no windows which open, and all the doors are kept locked. Air enters the structure from the south end through oil-coated air filters in the wall of the plenum room and is distributed by a fan through a system of air ducts. Each gas-engine-driven compressor has independent oil-type air filters on both the air-cylinder and the power-cylinder ends. In flowing to these filters, the air from the ducts does not pass over any intermediate hot surfaces. As a result, the temperature of the air admitted to the compressor cylinders is not materially higher than that of the atmosphere outside the building. The filters, each of which has an independent backfire release for protection, are located on the air-intake manifold of the engine. They extend out into the aisle between the compressors where they are in the sweep of the air issuing from the wall ducts. The starting compressor—a 6&3½x5 Type 30 with a 7½-hp. motor—is between the XVG machines, and its



BRAUN EQUIPMENT IN PLANT

Being a specialist in the manufacture of heat exchangers and similar equipment, the Braun organization naturally chose its own products for use wherever possible in the new power house. This view, which features a motor generator set and Freon compressors in the foreground, shows several pieces of equipment built on the premises.

air filter also is placed so that it obtains air that has not been in contact with exposed hot surfaces.

For a closed building, the power house is well ventilated. When it was being designed, consideration was given to radiated heat. As a consequence, the only windows in the structure have northern exposure so that no direct sunlight can reach the interior. All walls are of brick—a type of construction that aids in keeping the temperature down.

An additional factor that contributes towards operating economy is the closed cooling system that makes use of pure, soft water in the engine and compressor cylinder jackets. An abundance of soft water is assured by an automatic meter-controlled Zeolite water softener. Regeneration of this softener is automatically effected by a meter switch—all the plant operator has to do is to renew the salt supply whenever an indicator flag shows it to be dangerously low.

The heat exchangers are arranged in a way that simplifies cleaning. They are stacked and located so there is ample free space on both ends of each rack. This is also true of the Braun intercoolers. The exchangers are constructed so that they can be cleaned with the tube elements in place—the latter being made accessible for full-length cleaning by removal of the channel and body cover and the floating head.

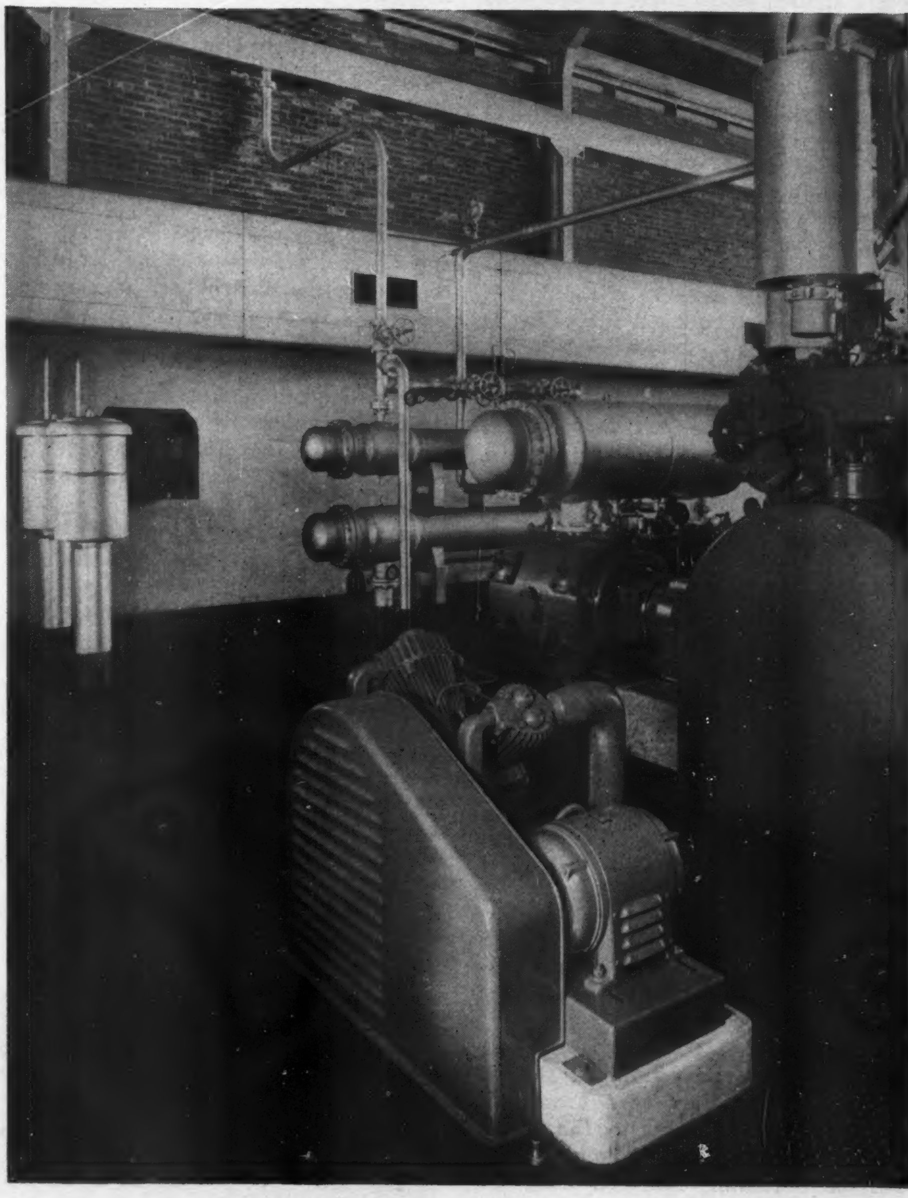
To provide for occasions when the air pressure in the plant might fall below 35 pounds, it was deemed advisable to have a starting by-pass installed on each compressor unit, since pressure less than 35 pounds will not actuate the free-air unloading system on the compressor cylinders. These starting by-passes are unique in that they involve the use of two block valves: one an ordinary gate valve and the other a quick-opening valve. Between the two is installed a bleeder vent pipe extending to the floor level. This vent, which is open during working periods, enables the operator to detect any leakage in the main discharge block valve.

Another unique construction feature is that most of the control valves of the main and auxiliary piping are located beneath the steel operating floor. The stems of these valves extend through small holes to floor level but do not project above it. Special handles with socket-type connections are provided for opening and closing the valves.

A great deal of attention has been paid to the appearance of the plant, as the accompanying photographs readily show. One of the most interesting innovations from this standpoint is the design of the engine-cooling-water surge tanks. There are four of these: two for the present air compressors, one for the compressor to be installed in the future, and the fourth serves as a surge tank for the chilled-water system of the air-conditioning unit. These tanks are located on the west wall of the power house above the high point of the several systems and are flush-mounted between the four inside, main steel columns of the building. As these columns are on 20-foot centers, each tank is 19½ feet long, the remaining dimensions conforming to the depth of the beams and to the required tank capacity. Each tank holds approximately 100 gallons of soft water, and provision is made for flow control so that any necessary quantity of make-up water can be obtained from the water-softening unit. All tanks are complete with outlet and overflow connections.

Because of the exceptional insulation of the gas-engine exhaust and muffling system, it was necessary to provide some means of carrying away condensate and water which might possibly enter the muffler jackets from above. Each muffler has therefore been equipped with moisture drains which are also insulated for the protection of the operators. They extend from the muffler to a point below the floor and have an inverted double "U" bend that serves as a water leg and seals the pipe against the continuous flow of hot gases.

The general arrangement of the machinery, etc., was largely dictated by the design of the old power house and the appearance the company was striving for in the new plant. The arrangement of the piping, for example, was much simplified by locating all the water and air mains along the west wall, and all gas headers,



STARTING AIR COMPRESSOR

The Type 30, air-cooled compressor in the foreground furnishes air at 200 pounds pressure for starting the two gas-engine-driven main compressors. At the left edge of the picture will be noticed two filtered intakes that supply air, through piping underneath the floor, to the compression cylinders of the XVG unit at the right. Running along the wall above the filters is a duct for distributing conditioned air. Above this duct and crossing the brickwork horizontally are portions of the water surge tanks, of which there are four. A pipe connection extends from one of them to the aftercooler that cools the air discharged from the XVG unit.

meters, and regulators along the east side. The motor generator sets were placed closest to the north end so that they would be as near as possible to their switch panels and the outlets to the factory. The pump pit, in which are all the power-house service pumps, is near the north end and close to the cooling tower.

The four air receivers are cleverly concealed in the 23-inch space between the iron-plate floor of the new power plant and the concrete floor of the old one. They are approximately 21 inches in diameter, inside, and 39 feet 8¼ inches overall, and have a combined volume of 358 cubic feet. They are connected in parallel by 8-inch headers, one at each end, and each receiver has a 6-inch flanged neck at the bottom into which any water drains and from which it flows to an automatic trap located in an accessible pit beneath it. Additional receivers are located at strategic points in the factory buildings and the laboratory—an arrangement that greatly increases the storage capacity of the air system. There are also two air receivers underneath the starting compressor. These are approximately 12 inches in diameter by 15 feet overall, and have a total volume of 23½ cubic feet. To reduce line pulsations at the compressor end of the gas-engine-driven air units, surge chambers have been attached to the suction and discharge of each machine. They are cylindrical in shape, have semi-elliptical heads, and are approximately 6 feet 3 inches long. For the sake of appearance, these surge chambers also are located beneath the floor.

In the southwest corner of the structure is the plenum room containing the air filters and ventilating fan. From this room extends the duct carrying the filtered air into the power house. The main duct from the ventilating fan runs along the west wall, the center line of the duct proper being about 10 feet above the steel floor. In the bottom of the main duct are two gratings that discharge the air so that it is directly in line with the compressor intake filters. Two branches extend from the duct, one at the north and the other at the south end of the building. For neatness, these are carried underneath the floor across the room where they deliver air to the space beneath the switchboard gallery where the gas meters, cable racks, etc., are located. From this enclosed space the air passes upward through the extra-large holes provided for the cables that serve the switchboard and is discharged back of the latter into the power plant.

The cooling tower for the power house is a 6-section Braun structure 52 feet high. It is located slightly above the power-plant level so that there is always approximately 15½ feet of liquid head above the center line of the pumps. The main suction line from the tower is 10 inches in diameter and the discharge line leading to it is 8 inches in diameter, a feature that allows for future increase in capacity at such a time when enlargement of the power-house equipment is undertaken.

The soft-water circuits on the power cylinders of each gas-engine-driven compressor are controlled by a Fulton Sylphon 3-way valve. This automatically regulates the amount of soft water passing through the heat exchangers in order to maintain constant discharge-water temperature at the power cylinders.

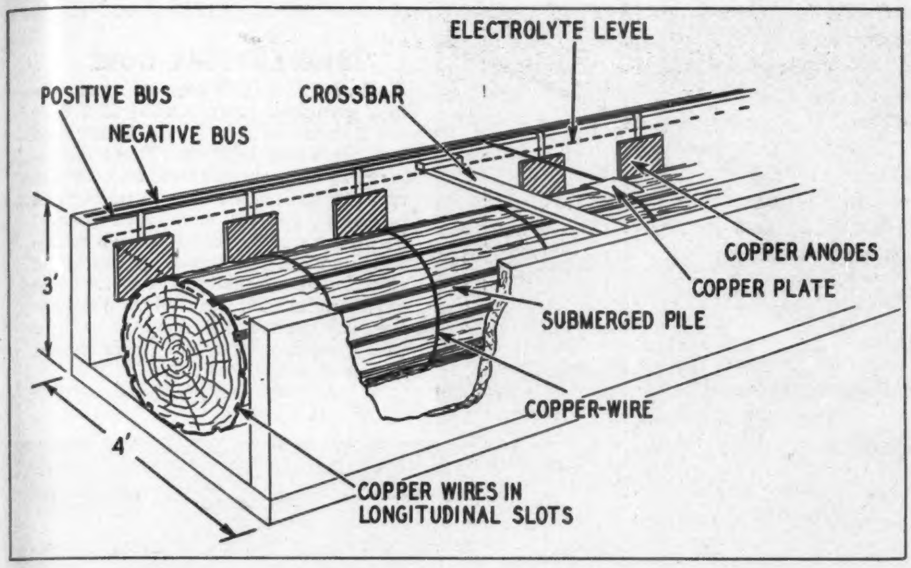
The high points in all water systems have automatic air-release traps to prevent any danger of vapor-binding in the equipment. Crosby safety valves have been provided on the air side of the intercoolers, on the discharge line between the high-pressure air cylinders and the aftercoolers, on the main-receiver outlet header, and on the two air-starting receivers. The outlets of all the safety valves are connected to a header which, in turn, discharges to the atmosphere through an oil, air, and water scrubber. All intercoolers, aftercoolers, heat exchangers, evaporators, and condensers are of C. F. Braun & Co. design and manufacture.

In the year of operation since the completion of the plant, the compressor capacity has been very close to the load factor of the factory. The two machines have a total capacity of 2,496 cfm., actual free-air delivery, and their operation is now so balanced that the 300-hp. unit carries most of the load during the day shift and the 225-hp. unit alone serves the night shift. Each compressor is arranged for automatic speed and pressure regulation and 5-step free-air unloading so that it floats on the line, varying in speed as the load increases or decreases until the load is approximately half of its rated capacity. At this point the free-air unloaders proceed to unload the compressor still further to an ultimate no load.

In all respects, the new power house has completely justified the intelligent planning that characterized the initial stages of the project and the actual building.

SHOP VIEWS

Two views of fabricating and assembly bays in the factory. Each of the overhead projecting booms carries an industrial-type air hoist, there being more than 120 of them in the plant. The generous use of hoists of this kind reduces the burden on the traveling cranes and speeds up work.



ELECTROLYTIC TANK

The drawing gives details of the treatment tank and indicates how a log is prepared for the electroplating procedure. The photograph shows a pile just before being submerged. The workman is placing one of the copper cathode plates on one of the encircling wires.

Timber "Copperplated" to Frustrate Worms

Henry W. Young

AS PART of the ceaseless warfare that must be waged against the insect world, man has classified his tiny enemies, prepared various poisons and deterrents, and invented ingenious methods of applying them—all in an effort to prevent infiltration and infestation. Represented in these enemy battalions are marine borers, termites, and boring worms, all working in wood. Among them are the voracious little devils that will quickly reduce a new, sound pile or other timber under sea water to a useless honeycomb. Other classes of worms hatched from the eggs of fluttering insects will, in a span of seven to ten years, render fire-killed standing timber that still has commercial value unfit for lumber. Without their depredations, such stands could be logged after the expiration of a much longer period.

For example, during the greatest forest fire in recorded history, the Tillamook Burn in Oregon, 262,000 acres of the finest timber in that state was burned over in about 40 hours. It represented 11,000,000,000 board feet of lumber, enough for 600,000 five-room houses. It would have taken 14,000 men six years to cut it; and a sawmill with a capacity of 250,000 board feet per day could have run 300 days a year for 146 years before completing the job. But the insects moved in to raise families as soon as the heat had died down. Their economy knows no markets and no labor conditions. Nothing holds up their cradle-to-grave program. They start immediately, in force, and when they have finished, the grave is already dug. And so, in spite of all efforts, the bulk of that timber could not be salvaged in time.

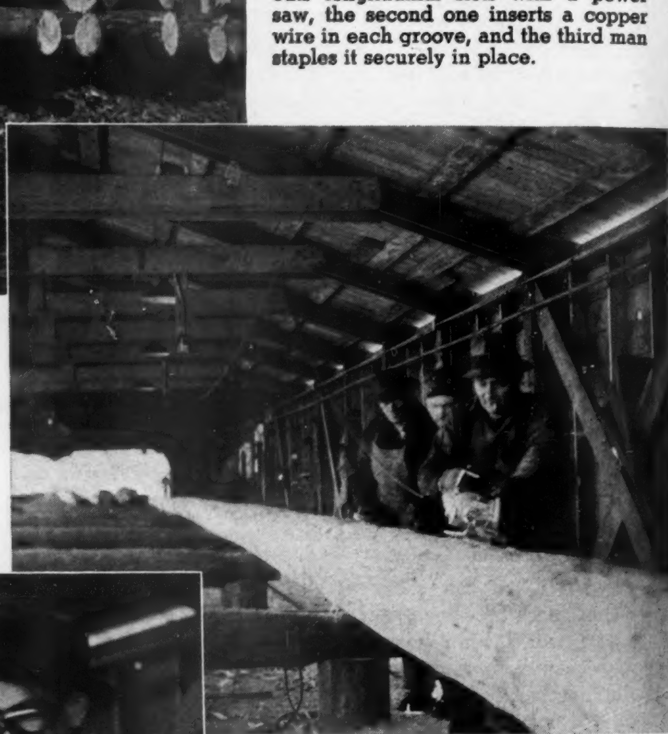
These facts are mentioned merely to prove that the enemy cannot be underestimated. Recently, however, a new method of defense against such pests has been successfully applied. It is effective because copper, in the form of copper sulphate, is placed in the way of the worms and prevents them from doing their destructive work. While it is not possible, of course, to treat a whole forest of standing timber with copper sulphate, it can be applied to piles that are to stand in sea water, to prefabricated lumber, railroad ties, pole stubs, and to anchor posts on electric lines.

The new process has been developed on a commercial scale within the last two years by the Olympia Wood Preserving Company of Olympia, Wash. The president, H. S. Andrews, patented it in 1925 and has been working on it painstakingly since that time. When it was ready—when the results proved beyond question that the method was practicable—a commercial plant was constructed and is now engaged principally in the treatment of wood piling for the Navy. However, some preparatory work has been done in connection with the treatment of railroad ties and prefabricated lumber, both of which will represent wide fields of application after the war.

It has long been known that the presence of copper sulphate in wood fibers will keep out teredos, termites, and all kinds of boring worms. For years attempts were made to protect timber by simple immersion in a copper-sulphate solution; but when the wood was subjected to water afterwards, the sulphate, of slight penetration, soon leached out and left it unprotected. "I had to find some way to make the sulphate penetrate to an appreciable depth and stay there," said Mr. Andrews. That was his problem, and he solved it finally in an astonishing manner—by "electroplating" the wood. The word "electroplating" is, of course, used loosely; for it is impossible to hang a piece of wood in an electrolytic cell, call it the cathode, and get any action. The cathode must be a conductor—metal—to receive the deposit. Andrews solved the problem by secreting free copper in the timber to be treated. This copper constitutes the true cathode. Thus the electrolyte, consisting of a copper-sulphate solution, permeates the outer shell of the wood as it seeks to establish contact with the free copper, or cathode.

Speaking of his process, the inventor says: "In general, an ionization process of impregnation by copper sulphate takes place. True and lasting impregnation is secured over the whole surface to a depth of three-quarters of an inch. There are several contributing factors; namely, heat generated by the formation of naphthalene, capillary attraction, softening but not burning of the fibers by the acid solution, and osmotic pressure."

The plant is located on an arm of Puget Sound. No big factory building is in evi-



PREPARATORY WORK

Most of the bark is removed from the logs manually (left), after which they are transferred to a pretreatment shed and placed on bolsters. There the remaining bark and all sand and dirt are taken off by a steel rotary brush (bottom picture). Finally, three men (below) perform a number of successive operations on each pile before it goes to the yard for electroplating. The first one cuts longitudinal slots with a power saw, the second one inserts a copper wire in each groove, and the third man staples it securely in place.

dence; but one does see great piles of logs, which are transferred by derrick rigs from one part of the yard to another during the course of the operations. Conspicuous also are six electrolytic tanks ranging from 85 to 130 feet in length. Each of these tanks is 4 feet wide and 3 feet deep. They are capable of accommodating piles 60 to 120 feet long. However, before the logs are subjected to the electrolytic treatment, they go through an elaborate preliminary process.

First, the bark is removed by hand methods. Mechanical debarking equipment will be used eventually, but such equipment is difficult to obtain under present conditions. After rough peeling, the logs are passed to the pretreating shed where a number of them are placed on low bolsters. As the initial step, a man works the surface with a steel rotary brush, which removes the remaining small pieces of bark and cleans off all sand and dirt, leaving the timber fresh and smooth. He turns each with a cant hook as he proceeds. When this is done, the log is rolled to the ends of the bolsters.

Alongside the cleaned piece of wood come three men at a slow walk. The front one has a portable power saw, with which he cuts a longitudinal slot ¾ inch deep in the timber. The next in line feeds a 16-gauge bare copper wire into the slot and sets it in the bottom with a small hand wheel. The last man drives staples astride the slot to hold the wire in place. These operations are repeated until a succession of such slots, 8 inches apart, have been cut and wired all around the log or pile. They reach to within approximately 10 feet of the butt, which will be the cut-off point after the pile is driven. Toward the tip end, the slots are discontinued at what will be the mud line and the wires are brought out and "pigtailed" together. After the wires are in position, the pile is given a coat of metal-graphite paint down to the mud line. Then a 10-gauge, bare copper wire is wound around it and stapled in place, the individual spirals being about 14 inches apart. This concludes the preparatory work.

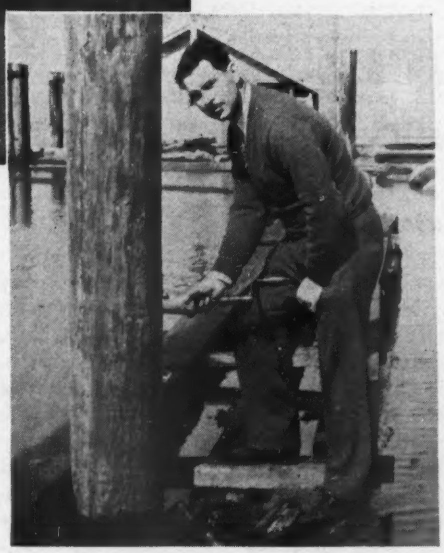
From the pretreating shed the timber is transferred by derrick to the yard and deposited in one of the electrolytic tanks, which do not differ in form from the ordinary variety. As shown in the accompanying sketch, the positive and negative bus bars are fastened to the top edge on one side of the tank, and copper anodes are suspended along that side in such a way that they hang beneath the surface of the electrolyte. The anodes are connected to the positive bus. The cathode element of the cell is represented by the wires in the slots, by the metallic paint, and by the copper spiral. The "pigtailed" longitudinal wires and the spiraled wire are connected to the negative bus, the latter by means of wires leading from copper plates laid on the spiral at intervals of about 10 feet. The pile is completely submerged in the solution and held there by crossbars.

The electrolyte consists of a solution of copper sulphate, sulphuric acid, and some other chemical elements not disclosed. As in the case of the ordinary electroplating cell, the metal of the anode is decomposed and deposited on the cathode, which, as we have already said, is the metallic paint and the copper wires in and around the pile. But there is more to it than that. Because of the electrolytic action and the contributing factors previously mentioned, the copper sulphate is apparently forced through the wood between the slots and left there in the form of microscopic particles of metallic copper, at the same time giving the surface of the pile a copper-colored sheen. After treatment, the timber is therefore completely surrounded by a shell, ¾ inch deep, that is thoroughly saturated with copper sulphate and with some free copper.

When the pile comes out of the tank,

CHECKING RESULTS

To determine the effectiveness of the copper impregnation, holes are bored in the piling below the high-tide line (bottom). These samples are reduced to ash, and the amount of copper in the latter is ascertained by volumetric analysis (right). Visual evidence of the effect of the treatment is given in the picture below. At the left are pieces of untreated piling after ten months' immersion in salt water. The wood has been honeycombed by teredos. At the right is a section of a "copperplated" pile that was subjected to identical exposure in the same location.



this copper-sulphated shell presents an impassable barrier to insects and marine borers. They have no storm troops or sappers that can even dent it. But beyond that there is a still more interesting phase. When the pile is driven, the longitudinal wires are in the slots but the spiral has been removed. Salt water is an electrolyte, and it has been found that an action similar to that in the cell continues for a long period after the timber is in place, the copper penetrating farther and farther as time goes on. In the case of some piles so treated and driven in salt water seventeen years ago, it was discovered that the copper had penetrated clear to the core and that the wood was sound and free from all infestation.

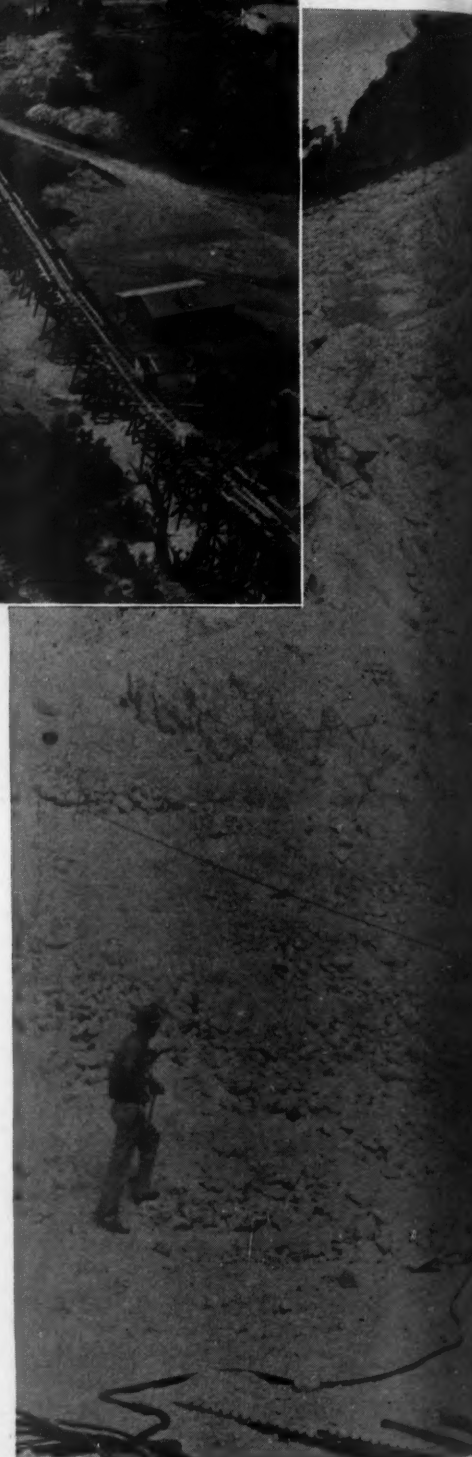
Here is a process so revolutionary that, after its efficacy had been proved, neither the Government nor anyone else wishing to utilize the product had any specifications covering the application. Therefore, the company established certain rules of its own regarding the procedure and the degree of treatment to be given. For one thing, it knew that the point of toxicity of copper for marine life had been set at 0.06. It was then decided to increase the "dose" drastically so that there would be no room for doubt. As a consequence, the method is regulated and timed in such a way that it will assure 21 times the aforementioned toxicity. The reason for this is twofold: First, the process gives a high margin of safety against infestation, and, second, it hardens the surface shell and practically eliminates fire hazard, for wood so treated will not burn; it will merely char.

All piles contain not less than 3 ounces of metallic copper per cubic foot. This means about 8 pounds of metallic copper for the average 60-foot pile. In the case of certain test piles that have been driven in salt water even more impressive figures have been recorded. After nine months' time, and after some sulphate had decomposed to form metallic copper, as much as 7 ounces of free copper per cubic foot was found in the outer shell.

The foregoing standards of impregnation are maintained by a well-equipped chemical laboratory. When piles are ordered, frequent sampling is done by boring 1-inch-diameter holes to a depth of 1 inch in those selected. The borings from each hole are divided into two parts, one representing the top and the other the bottom half. They are then reduced to ash, and the amount of copper per cubic foot is ascertained by volumetric analysis.

A substantial amount of electrical energy is required for the electrolytic process, and three motor-generator sets, with capacities of 5,000, 3,000, and 2,500 amperes, respectively, have been installed. The current is applied to the tanks at a pressure not exceeding 10 volts, the operation calling for 6 to 16 amperes per square foot of surface treated. To regulate the flow of current, each tank is equipped with an ammeter, a voltmeter, and a rheostat, and provision also is made for control from a central point.

Under present-day conditions, copper is a critical material. The uninitiated might ask why such an important metal is being used for this purpose while the war is in progress. The answer is that there are many pile-supported structures that are vital to the war effort. We suggest that the reader bear this in mind as he studies the accompanying photograph of treated and untreated wood. These two samples had been anchored side by side in sea water for only ten months. Yet during that period—probably long before the expiration of it—teredos had absolutely ruined the untreated wood. If that wood had been serving as a pile, a structure depending upon it for support might have collapsed. The teredo wages his own war—a blitz war. Since we can't blitz him in return, our only alternative is to go on the defensive; and in this case our defense is largely dependent upon copper.



PUMICE

—nature's unique abrasive

Fremont Kutnewsky

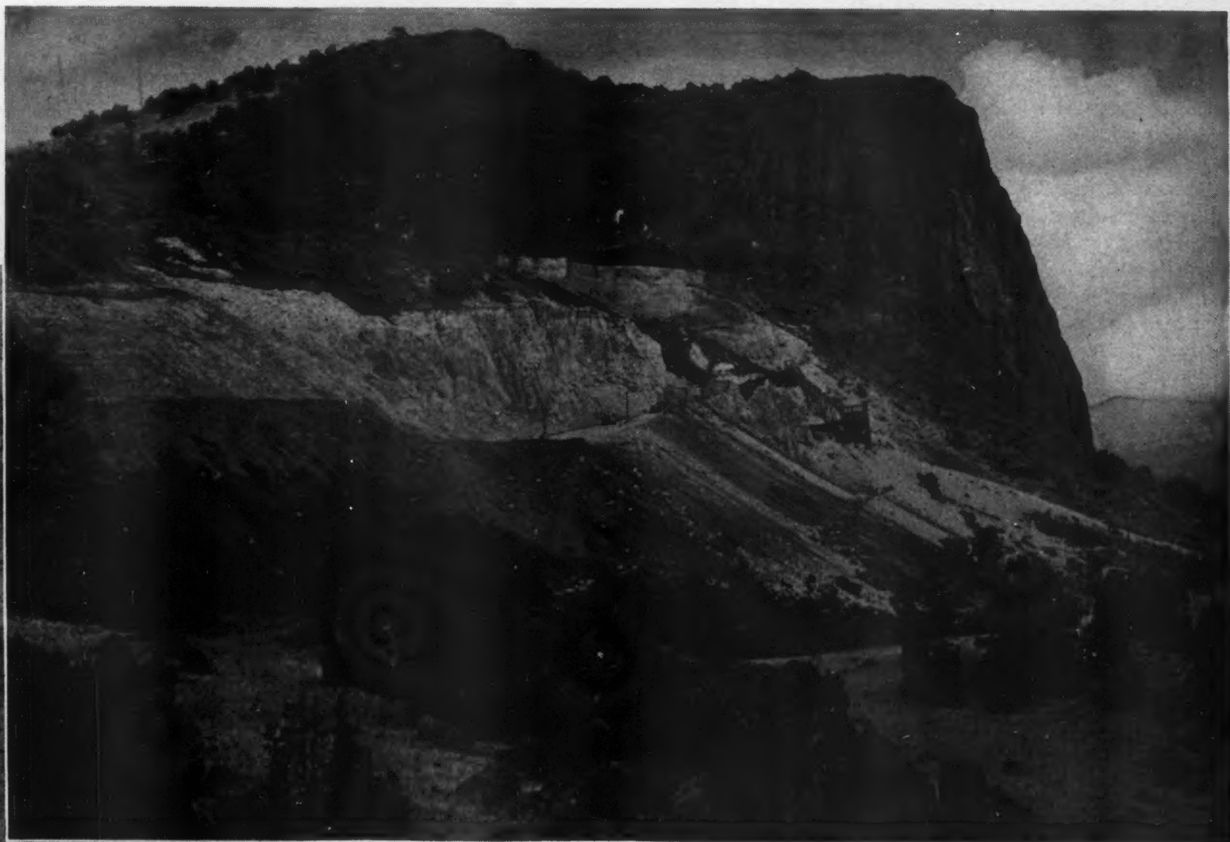
WHEN the second World War put an end to the importation of Italian pumice, there was no mad scramble in the United States for substitute sources on this side of the Atlantic. An exceptionally pure variety had already been discovered and developed in the American Southwest—in the Mount Taylor region of New Mexico. The pumice from Grants has been found to be not only equal but in some respects superior in quality to that which formerly came from the Lipari Islands near Sicily and which for many years set the world standard among users of this unique volcanic substance. The quantity available appears to be sufficient for all this country's needs for a long time to come.

The Mount Taylor deposit was originally developed by the Barnsdall Tripoli Corporation, makers of abrasives. Barnsdall was looking for a product that would compete with Italian pumice. The company erected a processing plant at Grants in 1938, and in 1941 The Pumice Corporation of America purchased the entire property, together with the trade name—Valencia Pumice.

Pumice is a mild, natural abrasive. Others of a similar character are tripoli, diatomaceous earth, chalk, fuller's earth, bentonite, and air-floated silica. Among the special services performed by pumice are polishing and finishing of wood, rubber, glass, metal, plastics, and painted surfaces. It is also a constituent in acoustic plaster, mechanics' soaps, and many patented cleaning and polishing compounds, and is used as a fluxing agent, as a treatment for suede leather, as an abrasive in rubber erasers, as well as for filtering and processing aviation gasoline.

Wood turners and furniture finishers utilize it to obtain that satiny, brilliant polish on varnished and unvarnished surfaces that is known as "piano finish"; dentists, to clean and polish teeth; engravers, electroplaters, offset pressmen, and lithographers to clean and prepare printing plates for sharp impressions; and the U. S. Navy, true to its tradition of immaculacy, uses pumice by the carload. Mirrors, pipestems, band instruments, and that large inlay in your tooth that your tongue fondles so irresistibly would not look nor feel the same without their pumice rub. There is no known substitute for the material for the special jobs it is called upon to do. It combines softness with roughness in just the right proportions to burnish delicate surfaces without marring them.

It is interesting to note in connection



THE MINE AND ENVIRONS

Above is a general view of the pumice deposit, showing the vertical face from which it is being mined. Beyond it, at the right, is a rocky projection which is thought to be a remnant of the plug in the crater of the extinct volcano from which the pumice was erupted. The center picture shows how the white, impure, pumice, after being blasted loose, is loaded into mine cars by a dragline device. The material is transported to a tipple and loaded into larger cars which carry it down an inclined railroad a quarter-mile to the washing and drying plant pictured at the upper left.

with pumice that the mirrorlike finishes we are accustomed to seeing on manufactured products are not given them just for beauty. Highly polished surfaces have helped to make mass production possible. They are instrumental in making machine parts fit and work together smoothly—without friction. It is with abrasives that modern industry achieves its amazingly close tolerances, for abrasives are the key to precision manufacture. Grinding, honing, and lapping are necessary in the case of labor-saving machinery.

When a soldier puts a shell into the breech of a gun he does so with the confidence that it will slip in fast and tight. Were it not for the polish achieved by means of abrasives, guns would jam and battles might be lost. Moreover, it isn't entirely for appearance' sake that soldiers are taught to keep their equipment bright and shiny. Tarnished gun parts would soon rust and deteriorate. Mess tins and cooking utensils would retain dirt and germs if they were permitted to become rough and dull; and everyone knows what happens to a pair of shoes that is never polished. In the case of many other articles in common use it is the original sheen that makes it possible to keep them clean and to get long wear out of them.

Polish protects and is pleasing to the eye. For hard-steel surfaces and for cutting gems there is a long list of manufactured abrasives, while pumice is the ideal material for delicate surfaces. You may not like the feel of mechanics' soap on your hands, but you will have to admit that the abrasive washes off. It doesn't work into the pores and cause irritation. That's because of the texture of pumice. Being cellular, it breaks down endlessly.

Pumice is found only in volcanic regions. It is a variety of lava, having a porous, fibrous structure that is spongelike in appearance. When broken down, its particles are hard and cubical; and even when the material is ground exceedingly fine it retains the roughness that makes it a good polisher. It is of glassy composition, containing from 60 to 75 per cent of silica, combined with aluminum, iron, soda, potash, calcium, etc. It may also contain small crystals of feldspar, augite, hornblende, and zircon; but these lower its quality because they wear too slowly and scratch delicate surfaces.

The *Encyclopaedia Britannica* says that good pumice is found in Iceland, Hungary, Nevada, and the islands of Teneriffe, Pantelleria, and Lipari. Before the war, and before the discovery of the deposits in the American Southwest, buyers in this country always preferred the Italian product. The older the volcanic area from which pumice comes, the greater will be the content of mineral impurities. Though it puts a high polish on other

things, pumice itself has no surface protection. It is a horrible example of what happens to a material without a "skin." Its porosity invites the entry of visitors from the entire mineral kingdom. If they're fine enough, they filter in. The American Southwest is one of the world's most recent volcanic areas; hence the Mount Taylor product has not had time to deteriorate through the infiltration of foreign substances.

Pumice is made when igneous rock erupts in a molten state from the depths of the earth and cools too fast for crystallization. When it reaches the surface, the pressure on the dissolved vapors within it are suddenly released, causing the material to swell into a frothlike mass that cools immediately. In the Mount Taylor region, some of the molten substance was transformed into obsidian—a volcanic glass from which the Indians fashioned weapons, tools, and ornaments. Obsidian is pumice that didn't explode but that is suitable for making pumice. All one has to do is first to heat it in a crucible until the fragments fuse and then to aerate it with compressed air.

The black, tough lava rock that has created vast, terrifying wastes in our Southwest is heavier and harder than obsidian and pumice. Instead of a high silica content, it is heavy with iron. It also melts at a lower temperature and flows around the countryside like lumpy mush. It resists deterioration and always looks as if it had just been ladled out.

One of the most tremendous volcanic eruptions of which there is knowledge occurred in 1883 on the small Island of Krakatoa in the Sunda Strait between Sumatra and Java. It was notable for the amount of pumice it turned out. Dust and ashes were blown 17 miles into the stratosphere, darkening the sky over Batavia 100 miles away and coloring sunsets the world around. Powdery clouds of pumice, driven by winds and air currents, stayed in the upper atmosphere long enough to drift twice around the globe. (This suggests a new use for the material, as a carrier for insecticides.) The eruption ejected so much pumice that the stuff settled on the ocean for miles around the island. It formed banks that floated like dry icebergs, sometimes projecting above the surface of the water as much as 4 or 5 feet. As a matter of fact, it is known that pumice covers the floor of the deepest parts of the oceans, but some of that material is attributable to submarine upheavals.

Mining pumice in the Mount Taylor region is a fairly simple matter, but it requires considerable equipment. The deposit lies near the top of a hill about 7 miles from Grants, a small town that is about halfway between Albuquerque and Gallup and is situated on the Santa Fe Railroad. The tough conglomerate of pumice and indurated volcanic mud is blasted in open-face operations and scooped or shoveled into iron mine cars. These carry it to a tipple, where a gravity tram takes the material about ¼ mile down the steep hillside to a washing and drying plant. After it is crushed to 1-inch-mesh size by means of sledges and toothed rolls it goes into a 4x20-foot scrubber.

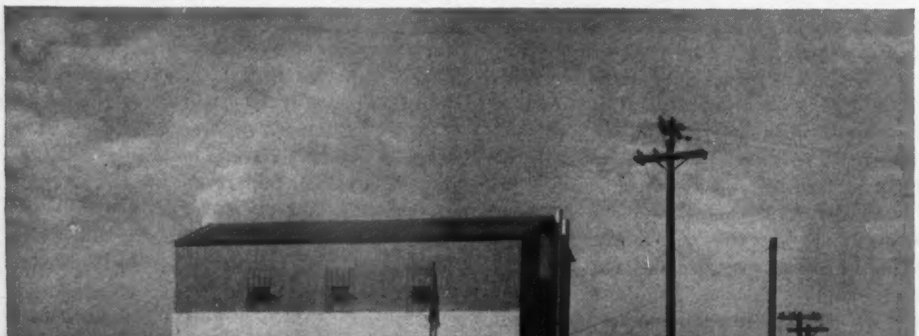
The cleaned product is trucked 7 miles to Grants, where The Pumice Corporation of America has set up one of the most modern and complete plants in the country for the preparation of pumice for the market. There the washed and dried material is redried and then crushed and graded by passing it through rolls, screens, and a ball mill. Valencia Pumice is processed into 21 standard sizes that range from ⅜-inch to −325 mesh. However, for special purposes, it can be further reduced to −400 mesh, putting it in a class with talcum. A great deal of it is ordered to specifications. Some purchasers want certain sizes shipped in unmarked bags, presumably for secret formulas.

The monthly capacity of the plant at Grants is 1,000 tons, and about 50 men are employed there. Because of the present strategic importance of the product to American industry, the company has been able to keep the volume of production at a fair level, although it is often a problem to obtain the necessary railroad cars, maintenance materials, and experienced labor. Under C. T. Griswold, general manager of the corporation's operations, experimentation goes on continually in an effort to widen the applications of pumice. One recent development is the use of the material in the manufacture of aviation gasoline. It has been utilized successfully as a packing material for vinegar generators, where its porous nature affords large oxidation surfaces that are favorable to the conversion of dilute alcoholic liquids into vinegar.

No one knows for what purposes pumice may next be employed. From time to time the producing company receives letters asking for detailed information as to the characteristics and applications of the material. For example, one writer wanted to know about the absorptive and sound-deadening qualities of pumice. He said he needed something to take the place of powdered cork for deck paint.

Before the modern era of packaged and specially prepared polishes and cleaners, pumice was a common household commodity that was used for scouring and polishing. Even now, most corner drugstores carry it, and if the war continues for an extended period, American housewives may again have to resort to this abrasive in its natural form. It is, of course, an ingredient in many of the compounded cleaners and polishes now on the market.

The principal difference between Valencia Pumice and its former Italian competitor is the color. The imported variety is gray, whereas the domestic product is dead white. Having fewer impurities, it is ideal for soaps and acoustic plaster. Pumice is a material that concerns manufacturers, chemists, and marketing specialists a great deal. It is a tool for the accomplishment of many special purposes in the complex round of modern industrial activity, and its uses are increasing rapidly as the result of man's insatiable curiosity and ingenuity.



SIZING PLANT AT GRANTS

Here the pumice, having been previously washed and dried at the mine, is processed into 21 standard and other special sizes for the trade. The product, some of which is ground to −325 mesh, is shipped in paper bags of triple thickness.

All photos, Compressed Air Institute

BLOWGUNS FOR SPECIAL NEEDS

At the left is the contrivance by which the paper strip from the roll at the left is fed into the waste basket in one direction while the metal strip that it protects is fed to the stamping machine in the other direction. A continuous stream of compressed air blown through the pipe on top of the container keeps the paper moving. The man at the right is separating lock nuts that have a tendency to stick together because of their lacquer finish. As they drop into the funnel-shaped mouth of the blowgun they are shot with air at approximately 90 pounds pressure per square inch against the heavy metal screen seen at the far end, where they are collected in a drum.

Compressed Air Can Do Many Odd Jobs

A. M. Hoffmann

COMPRESSED air has solved a number of annoying production problems in the plant of Tinnerman Products, Inc. The company manufactures self-locking speed nuts, clamps, and the like for airplanes and other fighting equipment. These are made of stainless-steel strip which is wound in rolls together with paper strip that serves to protect the metal surface. The job of separating the paper from the metal when feeding the latter to the presses caused a lot of trouble until company mechanics put their heads together and devised a simple form of blowgun which is fastened to the top of a large waste basket. A piece of pipe 3 inches in diameter and 2 feet long constitutes the barrel into which projects a 1-inch nozzle connected to a flexible air line. When stamping operations start, the end of the paper is inserted into the mouth of the gun, the air valve is opened, and as fast as the metal strip is fed to the dies the paper strip is carried along by the air current and deposited into the basket.

The other difficulty involved speed nuts that are given a finishing coat of lacquer applied by air spray inside a revolving barrel. In drying, many of the small, light pieces stick together, and by the old method their separation was time-consuming work. This is now done quickly and easily by a blowgun that likewise was built on the premises. It operates the same as the one just described but rests on a metal framework that also supports a tray. From the latter the nuts are dropped, a few at a time, into a funnel, at the base of which they are caught by a blast of high-pressure air that shoots them against a heavy-wire screen at the delivery end of the gun. The impact causes them to break apart, and they fall into a container ready for testing. This is an interesting operation and is done by means of a pneumatic vibrator developed by the company.

As one of the accompanying pictures shows, the nuts are fastened to a series of plates that are carried by a steel bar, a hand screw driver being used to secure the bolts so that they will be no tighter than a factory worker would make them. The bar is about 2 feet long and 2 inches wide and is clamped onto the piston of an air hammer mounted on a base plate. The amplitude of the vibrations thus imparted to it is $^1/_{16}$ inch, and the frequency numbers 3,500 cycles per minute. The tests usually extend over a period of 35 hours; but occasionally, under special circumstances, run as long as 1,000. It should be explained that the speed nut is an arched spring-steel stamping with prongs that are formed to fit the helical pitch of the screw threads. As the screw is turned, the arch is

PNEUMATIC VIBRATOR

Below is the machine by which self-locking speed nuts are subjected sometimes to as many as 10,800,000,000 sharp jolts to test their holding power. It is operated by the air hammer mounted on the right-hand base plate and tests sixteen nuts at a time. The vibrometer at the top indicates the frequency of the vibrations. At the right is the electric heat-treating furnace showing the elongated flue in the act of emitting fumes that are intermittently thrown off during the hardening process. The gases are discharged to the atmosphere by way of the cupola in the roof of the structure. The furnace updraft is induced with air at 60 pounds pressure that enters the flue at a point in line with the top of the furnace.

diminished and the prongs grip the screw with a double-spring tension lock that prevents loosening under repeated vibration. The theory on which the company works is that if 3,000,000 sharp jolts will not jar a nut from a bolt, then it has given ample proof of its holding power.

Another original application of compressed air in the plant is in the department where the small metal parts are oil-hardened in electric furnaces. There it serves to induce a draft to carry off furnace fumes, which are produced after the heat has started, when the oil remaining on the stampings begins to bake off. At that stage, a blast of air at a pressure of approximately 60 pounds per square inch is admitted into the furnace flue, thus drawing the gases upward and out into the atmosphere by way of a cupola in the roof of the building. The exhaust so induced continues for a period of less than five minutes, or until the draft from the furnace again becomes normal and completes the heat.

It is obvious from the few examples that have been cited—which, it should be remembered, all deal with a single plant—that it is possible with a little ingenuity to do a lot of odd jobs with compressed air.

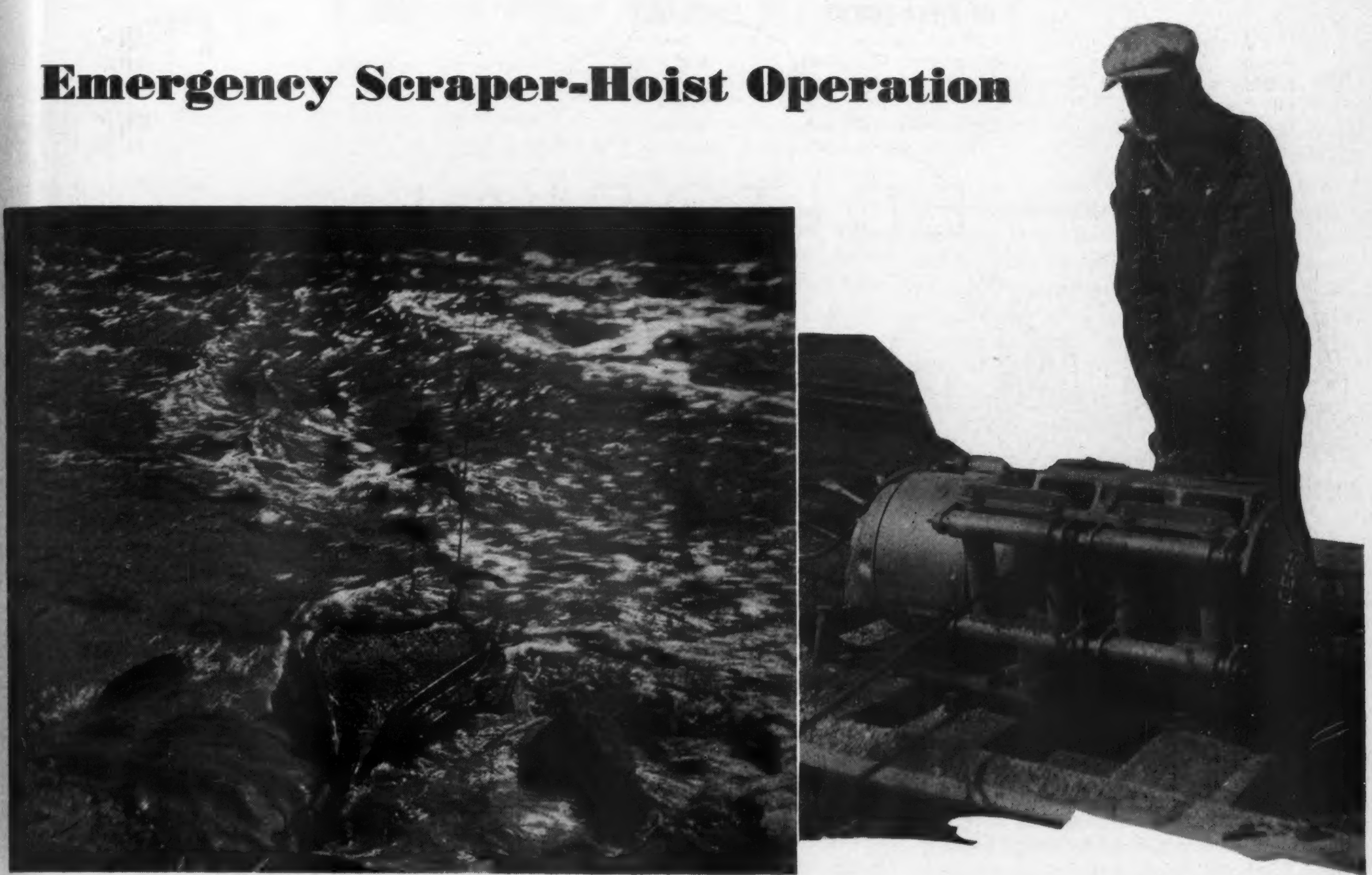
Rock Gives Warning of Dangerous Underground Conditions

STUDIES of rock pressures in numerous mines in the past five years have verified the idea voiced by Charles F. Jackson, eminent mining engineer, that rock under pressure squeals, even if no one hears it, and that the intensity and frequency of the subaudible noise might be a good guide to roof conditions in a mine. It has been proved that rock bursts, with their sometimes fatal results, can often be foretold and thus prevented by means of the Geophone, an amplifying and recording instrument that serves to determine the exact location of sounds transmitted through the ground. It is used for mine rescue work, by the military for detecting enemy underground mining operations, and for other similar services.

Writing under the heading *The Drift of Things* in *Mining and Metallurgy*, Edward H. Robie says that the geophone utilized for this purpose "is about the size of a stick of powder and can be stuck in an ordinary drill hole. Placed deep in the ground—below 1,000 feet—most rocks under pressure will emit a noise of variable character and volume every few minutes. The number of rock noises increases in general with depth, and depends more on the physical properties of the rock than on the geology. Disseminated porphyries and schists, with sericite and talc in the cracks and joints as a lubricant, for example, don't make much noise. The only deep mine in the country that is entirely free from rock bursts is that of the Magma Copper Company in Superior, Ariz., and that mine also has by far the fewest number of rock noises per unit of time.

"A practical use of the new electrical equipment is in the removal of pillars left to support the roof of a mine. Some of these have been found to be unnecessary, and as they usually consist of good ore—often of higher grade than that now available—their removal is most welcome at the present time. If the rock is not too noisy, then the pillar can be safely removed. Many thousands of tons of zinc-lead ore have thus been recovered in the Tri-State District."

Emergency Scraper-Hoist Operation



FLOOD-PREVENTION WORK

The double-drum hoist and scraper that were taken from underground to do an emergency job of sand and gravel removal above ground. The equipment quickly slushed the material from a point in a creek where a trestle prohibited the use of a power shovel or a clamshell. By releasing the backed-up waters, serious flood damage that threatened to put a stop to Anaconda Copper Mining Company's operations at Butte and Anaconda, Mont., was in part averted. The trestle serves the company's railroad, which moves all ore between the mines at Butte and the concentrator and smelter at Anaconda, and the Chicago, Milwaukee, St. Paul & Pacific Railway.

ONE Sunday in late March, 1943, the hills in and around Butte, Mont., were covered with the remnants of the winter's snows—in fact, the snow was 18 inches deep in many places. But during the day a warm chinook suddenly began to blow and continued unabated for several hours. The snow melted rapidly; Butte found itself menaced by its worst flood in 35 years. At Rocker, a point in a narrow valley 5 miles below the city, stands a mill that supplies all the framed timber for the Butte mines. The mill is at the bottom of the valley, being protected from Silver Bow Creek by a dike on the upstream side. This dike causes the creek to bend sharply, pass under a low railroad trestle, and then resume a course parallel to its original one.

Over a period of time, sand and gravel had accumulated on the stream bed beneath the trestle; hence the flow of the creek, even under normal circumstances, was impeded to a certain extent. When the flood reached its peak, the partially dammed trestle section was unable to pass all the water. The stream backed up, spilled over the dike, and eventually washed it out. As a result, the framing mill was inundated; on the lower floor the water rose to a height of 8 feet. The flood threatened to halt mining on Butte Hill and to shut down the smelter at Anaconda Copper, a multimillion-dollar industry. To alleviate conditions, it was necessary first to deepen the channel under the trestle so that the water would run off freely. The structure was too low to permit the use of a power shovel or a clamshell, but local engineers solved the problem in an ingenious way.

An Ingersoll-Rand 15NN-1G double-drum hoist was placed on one bank of the creek; the cable was run underneath the trestle; and a 30-inch scraper was brought into service. By this arrangement, the operator could remove an appreciable amount of sand and gravel with each trip of the scraper. Moreover, in addition to clearing out a substantial quantity of accumulated sand, the scraper so agitated the surrounding deposits that they were carried 50 yards downstream by the swiftly flowing water. At this point, well beyond the trestle, a clamshell could operate easily.

In principle, this hoist application paralleled closely the scraper-mucking methods that are now so familiar to the mining industry. However, it is doubtful whether many hoists designed for underground use have been cast in so spectacular a role. Reports from Butte indicate that the machine in question was largely responsible for clearing the stream bed and that, in so doing, it helped to prevent serious delays in a vital war industry.

Foot Comfort

OUTDOOR workers, miners, tunnelers, and others exposed to wet and cold should be interested in the new "ventile" wool-felt insole provided primarily to give foot comfort to our military forces in arctic regions. It is a product of the American Felt Company and is made of two layers of wool felt having a combined thickness of ½ inch. By stitching them together for about 5 inches on only one side, the layers are free to "work" under the intermittent pressure of the foot in walking. This, together with numerous perforations, permits the sole to breathe, to throw off the moisture that not only causes discomfort but may freeze, especially in the Far North. Other claims made for it are that it does not mat, is antiseptic, proof against fungus, and, when properly handled, will wash without stretching.

A Notable Mine Closes

ONE day in 1899, "Big Jim" Butler came trudging into Klondyke Wells, Nev., lugging a heavy bag of black rocks on his back. He insisted that the rocks contained gold, but they were black rocks, and everybody laughed at him because they knew that gold invariably was found in light-colored quartz. So Butler shouldered his sack and walked to Belmont. In the largest saloon there he told of having found a great deposit of the black mineral out on the desert in the San Antonio Mountains. He asked for a grubstake to go back and open a mine, but nobody paid much attention to him, as prospectors had long since condemned the desert stretches of southern Nevada as barren of mineral. Butler persisted, but his appeals fell upon deaf ears.

Finally a rancher, who had driven into town in his buckboard, listened to Butler and advanced enough money to permit him to go back to the desert and do some more digging. The first ore he sent back to an assayer ran $500 to the ton in gold and silver. There ensued the usual rush of fortune seekers, and the camp of Tonopah was born. Butler became rich in a few months, and at his wife's request sold out and retired to a farm in California.

Adjoining Butler's property, the Belmont Mine was developed. In 1902 it was acquired by the Tonopah Belmont Development Company controlled by Philadelphia capital. In 1906, the property yielded its first dividend, and there followed 48 additional payments, aggregating almost $11,000,000. The last one was paid in 1925, and much of the ore produced in recent years was mined by leasers. Now word has come that the Belmont has given up the ghost. Hastening its demise was a fire in October, 1939, that destroyed much of the timbering in the main working shaft and all the surface buildings.

During the 41 years that it was active, the Belmont disgorged millions of tons of ore. When the camp was young and the mines had not yet acquired sufficient depth to strike water, all the ores had to be shipped several miles to Millers for treatment. Then milling was not the exact science that it is today, and the tailings contained about $4 worth of metal a ton. In recent years they were reworked in a 600-ton cyanide plant.

The Belmont was developed through two vertical shafts, 1,127 and 1,718 feet deep, and many miles of drifts, crosscuts, winzes, and raises. At one time the owning company also controlled the Jim Butler and Tonopah Mining Company properties. Its most prosperous period was from 1910 to 1917. Scarcity of labor and high prices of supplies crippled activities in 1918, and the manpower shortage of the past year undoubtedly had a bearing on the decision to liquidate.

How Britain Eats

IN THESE days of ration books and Victory Gardens all of us are paying more attention to our food supply than ever before. Great Britain is a few jumps ahead of us in the battle of victuals, and we may profit from her experiences in maintaining civilian health and morale on a level designed to prevent the vital work behind the fighting lines from bogging down. Because of the small size of the British Isles, their great distance from sources of food supply, and limitations on the things that can be grown there, they have been confronted with food problems far more serious than any we shall have to meet. Nevertheless, Britain has kept her people fit for the daily grind, thanks to an intelligent governmental policy.

The crux of that policy is that everyone shall eat, that all shall be as well nourished as the food supply will permit, and that no individual or group shall be favored unless it be for reasons of age or physical condition. The constant aim has been to keep everyone useful, and sickness has been regarded as a national enemy. This has been accomplished largely through research and regulation. The Ministry of Food has had the benefit of much expert advice, and laws have been enacted to enforce the measures that it has deemed necessary. For example, there is a Sampling of Food Order that permits officers to enter establishments where food is being manufactured, stored, or sold, and take samples for examination.

It is the aim to provide vitamins in the form of natural foods rather than by artificially enriching natural foods or by taking them in the form of tablets or capsules. The only exception has been the addition of vitamins A and D to margarine to the extent that they are contained in butter. There has been no occasion for enriching bread as we are doing in the United States since millers are permitted to produce only one kind of flour—national wheatmeal flour, and its content of vitamin B_1 is from two to three times that of straight-run white flour. The public is expected to obtain sufficient vitamin C by following a proper diet of vegetables. Information on the foregoing and other points is disseminated to housewives through a nationwide publicity program. This includes posters, radio talks, advertisements, and motion pictures. Cooking classes and cooking demonstrations are conducted throughout the country, and the Ministry of Food's "household kitchen" prepares recipes and gives advice on special meals for an average family of four persons.

Concessions are given to nursing mothers, infants, school children, and heavy workers, as well as to persons put on special diets by physicians. Since last summer ordinary consumers have been allotted milk only after the needs of these priority consumers have been met. Oranges are reserved for children under five. They and expectant mothers also receive fruit juices and cod-liver oil through maternity and child-welfare clinics at little or no cost. Heavy workers may have an extra ration of cheese, and nearly 1,000,000 children are served balanced, hot midday meals at school.

As a result of these measures the public health of the British Isles is better than it was before the war.

Log of Our War Economy

THE following paragraphs contain significant bits of information culled from official press releases sent out by the War Production Board.

APRIL 9—It has been announced by OWI that the 2,240 Federal agencies listed in the Federal Register are doing a better job of salvaging materials than ever before in their history. Exclusive of the Army, the Navy, and the Maritime Commission, they are expected to recover between 100,000 and 120,000 tons of scrap material this year, including iron and steel, nonferrous metals, and paper. As of March 1, 1943, the scrap material collected by federal agencies since June 15, 1942, totaled 20,345 tons.

The quota for the 1943 Great Lakes iron-ore movement has been tentatively set at 95,000,000 tons. This goal is 3,000,000 tons greater than the record established in 1942, and 15,000,000 tons more than was transported in 1941.

APRIL 12—The output of anthracite coal for the week ending April 3 was estimated at 1,357,000 tons by the Bureau of Mines. It is believed that anthracite production must be maintained at a weekly average of at least 1,250,000 tons to meet the nation's requirements for 1943.

APRIL 13—It was announced that trailers represented approximately 14.5 per cent of the new housing units that were constructed either publicly or privately for war workers during 1942 with priority assistance. Nearly one-third of the trailers built last year were purchased through Government housing agencies.

The April distribution of chemicals under allocation orders of the Chemical Division had a value of approximately $131,000,000. More than 47 per cent of this total entered into identifiable military production.

APRIL 15—Joseph B. Eastman, Director of ODT, called attention to the great increase in the use of the country's inland waterways. Coal is moving in large volumes on many of our navigable rivers, as are steel, scrap iron, and sulphur. Great Lakes carriers, in addition to transporting huge quantities of iron ore, moved more than 49,000,000 tons of coal and more than 94,000,000 bushels of grain last season.

Electric storage batteries may now be bought by farmers to operate shocking devices and other farm equipment, according to WPB. Dry-cell batteries, formerly used for these purposes, are no longer available.

If estimates of 1943 food production are correct, civilians will have less of certain foodstuffs and more of others this year than in 1942. Among the former are meat, of which there will be 11 per cent less; canned fish and shellfish, 27 per cent; butter, 21 per cent; cheese, 11 per cent; canned milk, 15 per cent; canned fruit, 51 per cent; canned vegetables, 27 per cent; dry beans, 6 per cent; sugar, 22 per cent; rice, 21 per cent; coffee, 29 per cent; tea, 60 per cent; and cocoa, 12 per cent. Of the following, on the other hand, there will be more: chicken, 30 per cent; margarine, 57 per cent; apples, 9 per cent; frozen fruits, 13 per cent; wheat, 7 per cent; and rye, 13 per cent. Of fresh and frozen fish, eggs, turkey, fluid milk and cream, lard, fresh citrus fruits, canned fruit juices, dried fruits, tomatoes, potatoes, corn, oats, and barley, civilians will have about the same amount.

APRIL 16—By changing from tin to cardboard, the manufacturer of one type of tobacco container has made available almost 7,000,000 pounds of tinplate for war production. A manufacturer of cookie boxes has, by changing to paperboard containers, released more than 2,000,000 pounds of tinplate. A maker of adhesive tape has saved 429,000 pounds of metal by adopting a cardboard spool container.

APRIL 18—In Denver, a mile above sea level and separated from sea water by hundreds of miles of rugged country, is the Rocky Mountain region's most surprising industry—shipbuilding. Eight iron-working firms have accepted a $56,000,000 contract to fabricate hulls, bulkheads, decks, and other sections for 24 naval vessels. After fabrication, the sections are shipped by rail to the Navy's shipyard at Mare Island, Calif.

APRIL 23—It was announced that there are 283,000 new bicycles currently available to war workers and other civilians who qualify under newly liberalized rationing regulations. Most of the 10,000 bicycles still being produced each month are required by the armed forces, but those that remain go into the civilian stockpile.

APRIL 26—Joseph B. Eastman, Director of ODT, asked that business and industrial organizations schedule employee vacations so that they will begin and end on Tuesdays, Wednesdays, or Thursdays. The purpose of this request is to alleviate week-end traffic congestion. He also suggested that holidays be spread throughout the year instead of being concentrated during the summer months.

By regulating the transfer of workers to better-paying jobs, in accordance with a recent action of Manpower Commissioner McNutt, the turnover of labor in war industries is expected to be reduced 50 per cent.

About 60 per cent, or $2,700,000,000, of the estimated $4,500,000,000 needed for the 1943 government-financed industrial plant expansion will be spent on machinery and equipment, as compared with 45 per cent last year. The remaining $1,800,000,000 will be used for construction.

APRIL 27—The quota of new passenger automobiles for rationing in May has been increased to 50,000. The April allotment was 38,000. In addition, there are reserves totaling 14,200 that may be called upon to fill demands in excess of the quota.

APRIL 28—It was announced that a yearly saving of approximately 8,000 tons of zinc has been effected by changing the tops of mason jars from zinc to steel. Moreover, approximately 500,000 pounds of rubber has been conserved during the past six months by the use of wool felt in the manufacture of washers, gaskets, and similar associate items.

According to OWI, price reductions on war-production contracts, refunds by contractors, and miscellaneous recoveries effected through renegotiation of contracts by the War and Navy Departments and the Maritime Commission between April 28, 1942, and March 31, 1943, amounted to $2,539,000,000.

APRIL 29—During the first two months of 1943, shipments of iron and steel scrap to the consuming mills amounted to 31.3 per cent of the first half-year quota for 1943, the Salvage Division announced. At the top of the list in the nation-

A sidewalk superintendent of the future

wide drive is California, which reached 42.2 per cent of its quota by the end of February.

April 30—It is stated by WPB that the saving of 200,000,000 pounds of waste fats—a tablespoon a day per household—is vitally necessary to the prosecution of the war and to the maintaining of essential supplies of military, lend-lease, and civilian items that contain glycerine. Since all other potential sources have been exhausted and all nonessential uses prohibited, waste-fat collection alone can do the job.

May 1—Steel-industry workers will be on a 48-hour week by July 1. This will not increase the output, which is now nearing capacity, but will reduce the number of men required. The industry is now working an average of 41.5 hours a week.

May 2—Conservation of coal by curtailing passenger-train schedules is under consideration. Meanwhile, the public is being asked to defer all unnecessary rail trips.

May 3—In April, merchant shipyards delivered for service 157 vessels, totaling 1,606,600 tons dead weight, breaking the previous production record.

Tire and tube manufacturers are being allotted limited quantities of Buna S synthetic rubber to enable them to organize plant processes and personnel for utilizing the new material. It is expected that they will interchange technical information and performance records so that the entire industry may benefit.

May 4—That gasoline rationing has reduced driving is shown by official figures. Motor-fuel tax collections in March in 29 states were 28 per cent under March, 1942, and in the eastern rationed area they declined 40 per cent. The Public Roads Administration says that there was 48 per cent less traffic on rural roads in the eastern rationed area in March than during the same period a year ago.

May 5—Production of aircraft is rapidly becoming a "woman's industry," declared Paul V. McNutt of the Manpower Commission. From 70 to 80 per cent of the workers now being hired are women, and employment figures show that about one-third of the force in airplane plants is of that sex. This proportion is expected to rise to at least 50 per cent by the end of the year.

May 6—Sharp emphasis is placed on the increase in war mechanization by the fact that the quantity of petroleum and petroleum products carried overseas in the first twelve months of this conflict was more than 80 times that shipped across in the first twelve months of the last war.

Portable pipe lines suitable for carrying gasoline supplies to motorized units in the field have been developed by the Army. According to the publication *Army Motors*, this type of pipe line comes in self-contained half-mile units, each of which is complete with a centrifugal pump driven by a 20-hp. gasoline engine.

Lend-lease exports during March exceeded the previous highest month by 20 per cent and totaled more than $7,000,000,000 up to April 1. American-built planes, tanks, and trucks are playing increasingly important parts in the fighting on all fronts.

A rag-salvage campaign has been recommended to insure an adequate supply of wiping cloths for military and industrial purposes. Most rags which are now burned after one use can be reconditioned for further service. Civilians may be appealed to to follow similar reclamation practices.

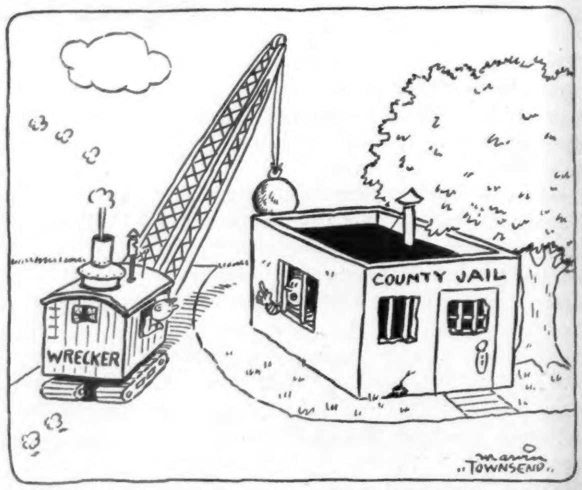
Production of small diamond dies, which are important for drawing fine wires, is reported to be ample for our war needs. The United States is now the sole source of new dies, and the quality of those being made is improving continually.

May 7—The electric-power generating capacity of Bureau of Reclamation projects in eleven western states has more than doubled since July 1, 1941, and now totals 1,790,000 kw. The most recent addition at Grand Coulee Dam is another 70,000-kw. generator, the second in three months.

Steel-plate production in April was 1,121,647 tons, setting a new record for a 30-day month. Molybdenum is in the most critical position among the alloying metals for steel, its current consumption being greater than the output. The use of nickel, chrome, and vanadium has been reduced, but only at the expense of increased utilization of molybdenum and manganese. Because of the late opening of the iron-ore shipping season on the Great Lakes emphasis is being placed on the importance of continuing the flow of scrap to steel mills.

May 10—When householders apply for fuel-oil rations next winter they will not be asked if they can convert oil-burning furnaces. The Government will, however, continue to insist upon conversion, wherever possible, in other than private dwellings. Because of transportation bottlenecks, householders using coal are urged to order next winter's supply now.

May 11—The Division of Labor Standards, Department of Labor, has available for free distribution a booklet showing how managements of 200 outstanding war plants deal with the problem of absenteeism. Chairman Donald M. Nelson of WPB today requested that regular work schedules be observed in all war plants over the Memorial Day and July 4 weekends.



"Pssst! Could I speak to you for a minute?"

May 12—Leaves of absence to permit industrial workers living on small farms to plant and harvest crops were advocated by the War Manpower Commission and the War Food Administration.

Total war expenditures of the Government up to May 1 were $94,900,000,000. In April the average daily rate of spending was $280,400,000, or approximately $2 per capita.

May 13—Despite manpower and materials shortages and the demand of the armed forces, makers of sleeping equipment are keeping pace with civilian requirements. This is being accomplished by simplifying manufacturing specifications and by using substitutes for the critical war materials that were formerly employed.

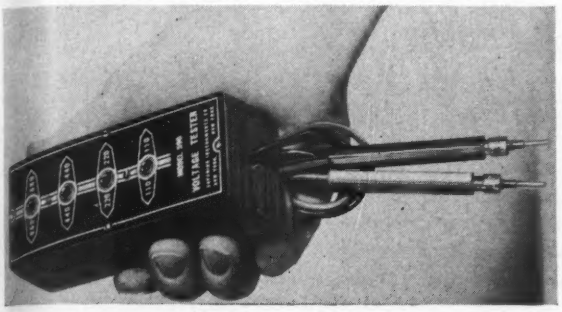
May 14—Silver-plated tableware is becoming scarcer and patterns are greatly limited. Manufacturers are restricted to the use of one-half the metal they consumed in the year ended June 30, 1941, and five of the ten largest flatware plants in the nation have been converted largely to war work. The silver saved is being utilized in many kinds of war work; that is, for airplane-engine bearings, brazing alloys, electrical equipment, and containers for corrosive chemicals.

May 15—A harbinger of winter: steps are being taken to standardize snowplow cutting edges of which there are now more than 400 varieties.

The chances of any civilian getting a new telephone are slim, available supplies being practically exhausted. The telephone industry has to get along this year with about 10 per cent of the materials consumed in 1941.

Industrial Notes

A voltage tester that is read like a thermometer has been developed by the Superior Instruments Company. The Model 590, as it is designated, requires no accessories and, by connecting two needle-pointed test prods across any electric line, will, it is claimed, automatically indicate the voltage (from 110 to 660), the frequency, the type of current, etc. It consists of four NE-7 neon bulbs that are permanently protected against jarring by a subassembly housing, and of a network of resistors encased in a wooden box measuring 1¾x5x1⅝ inches. The instrument weighs only 5 ounces. It is designed for "bang-around" service and is said to be adequate for most electrical maintenance requirements.



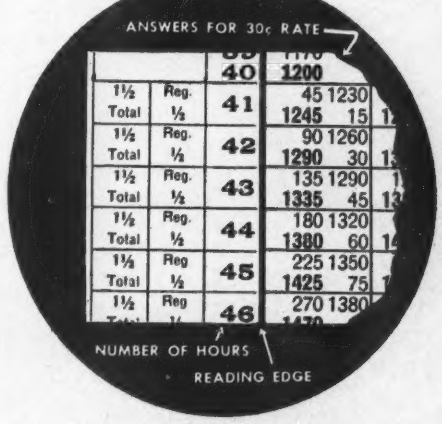
Dividends from Your Power Plant is the title of a 48-page booklet written for executives so that those without extensive engineering training can understand the principles governing the economical operation of steam-generating equipment. The publication consists of ten short digest-type articles on as many topics related to the proper selection of equipment and to the cost-producing elements of steam generation. The aim is to induce managements to scrutinize steam production not as a fixed overhead expense but as a relatively controllable cost that is a definite factor in the final price of the product or service. The discussions cover such subjects as the dollars-and-cents importance of boiler efficiency; the relation between steam costs and profits; natural versus mechanical draft; carbon dioxide and carbon monoxide; excess air; and factors that govern labor costs in the boiler room. The text is clarified by examples, tables, and sketches. The book is not a sales bulletin in the sense that it describes any particular product or apparatus, but is being distributed by Preferred Utilities Company to help boiler owners reduce steam costs and realize the benefits of more reliable operation of boiler-room equipment. This is of particular importance today when managements are faced with the problem of keeping equipment in continuous service at peak capacity; when repair parts are difficult, if possible, to obtain; and when skilled workers are becoming increasingly scarce. Copies of the publication may be had without charge by writing Preferred Utilities Company, Inc., 33 West 60th Street, New York City.

The Dayton Rogers Manufacturing Company, Minneapolis, Minn., is offering for free distribution a cutout model of a pneumatic die cushion as applied to the average punch press. Through the medium of a slide, the model shows plainly how the moving parts function—how the blank is automatically held in tension and how the press tools produce a smooth shell throughout the work cycle of the draw die. It also indicates the features by which a single-action press can be used in place of a double-action press, or a double-action instead of a triple-action press, and gives in detail the basic working parts of any standard die cushion, together with a complete piping-installation diagram. The model is 8½x11 inches in size.

WIND TUNNEL

This equipment is used at the Westinghouse East Springfield works in testing bomb fuses. The operator is inserting one in the constricted tunnel passage where it is subjected to a 500-mile-an-hour wind induced by compressed air. At this velocity the fuse action is the same as it would be under actual bombing raids. The air is controlled by a reducing valve; an automatic timer measures the duration of the flow; and a gauge indicates the pressure before and after the test.

"A slide of the hand gives the answer." That is what the Graphic Calculator Company, Inc., says about its recently developed and patented Wage Master that simplifies the work of making up payrolls. The board presents a wide range of rates and hours in larger than typewriter type by means of a sliding arrangement that provides a reading edge for every column of figures to eliminate the chance of error. It gives hourly rates from 30 cents to $1.30 in half-cent steps and from $1.30 to $2.12½ in 2½-cent steps; calculates pay for regular time, extra time, time and a half, and total; and includes rates for fractional hours in tenths and quarters, as well as the standard Victory Tax schedule. The Wage Master measures 12x16 inches, closed, is scratchproof, impervious to moisture, and made to give long service.



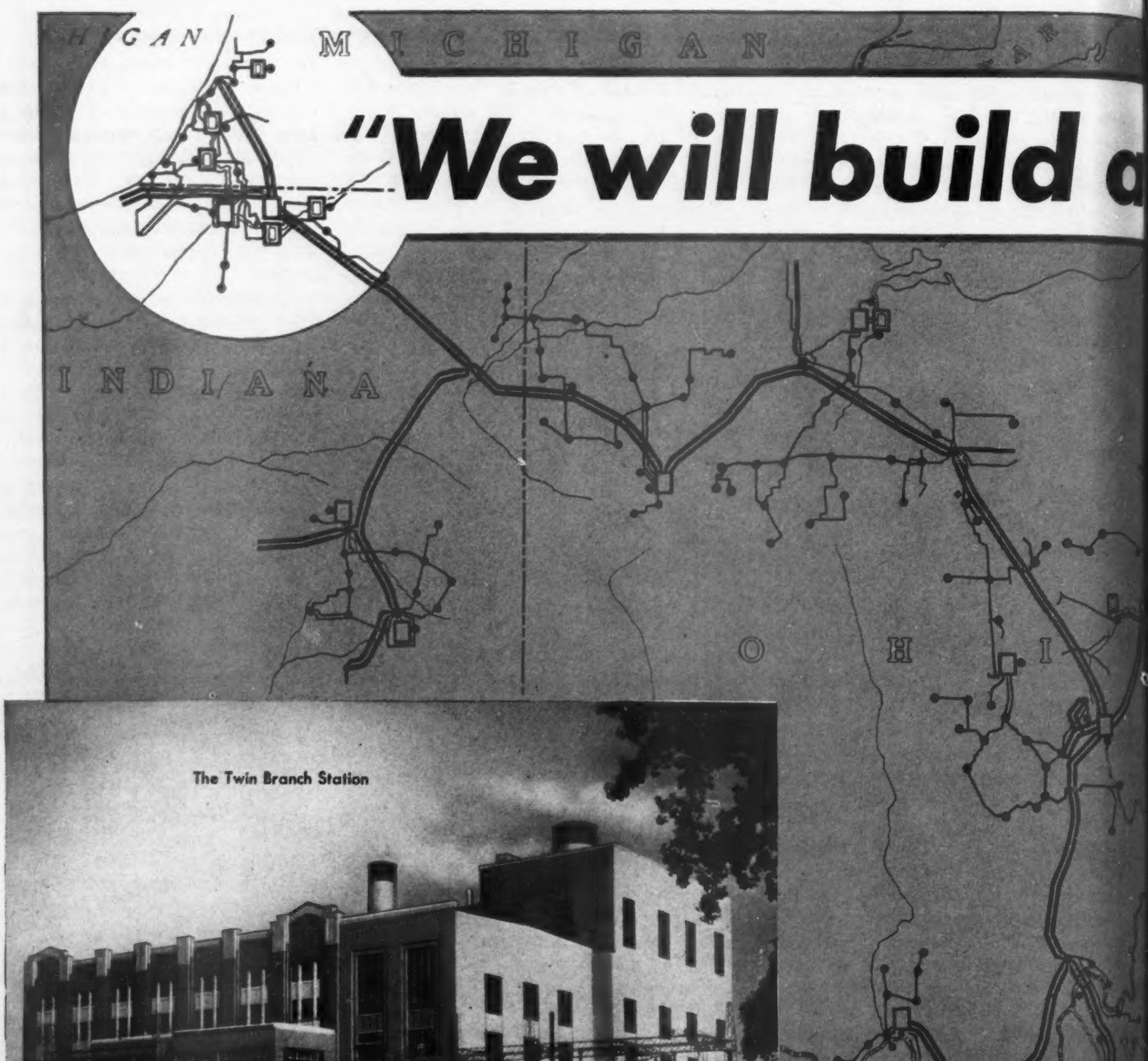
HOW IT WORKS

Section of the Wage Master a trifle smaller than actual size. The set of four figures opposite each of the numbers of hours worked indicates earnings in dollars and cents. If a man has put in 41 hours—one hour overtime—at the rate of 30 cents an hour, his total pay would be $12.45, the heavy figure next to the reading edge. The light figures represent time and a half, 45 cents, upper left; regular time, $12.30, upper right; half time, 15 cents, lower right.

Completion of the first synthetic-rubber tire to be manufactured entirely of Government-produced materials was announced recently by The Goodyear Tire & Rubber Company. The plants that supplied the styrene and butadiene of

(Continued page 7075)

"We will build a 25

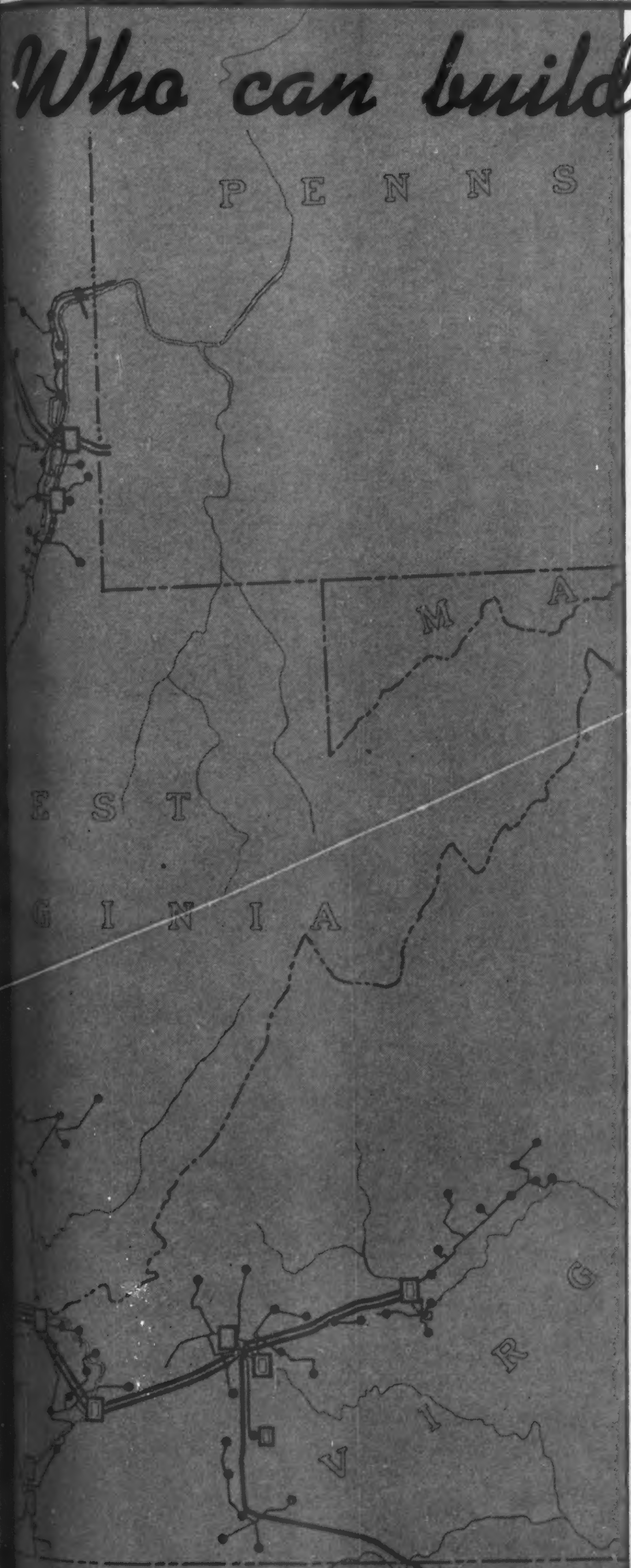


The Twin Branch Station

... the 2800 psi boiler-feed pumps for Twin Branch Station.

a 2500 lb. station here"

Who can build the boiler-feed PUMPS?



When the American Gas and Electric Service Corporation planned a 76,500 kw high-pressure addition to the Twin Branch Station, no one had ever built boiler-feed pumps of this size for 2800 lb. per sq. in. pressure.

For years Ingersoll-Rand has been a leader in the manufacture of high-pressure boiler-feed pumps and had furnished pumps for every steam station in American Gas and Electric's Central System. So it was natural that Ingersoll-Rand should be asked to help solve the pump problem at Twin Branch.

Three 8-stage, boiler-feed pumps were supplied. Each has a capacity of 1230 gpm, a discharge pressure of 2800 psi, a suction pressure of 700 psi and handle boiler-feed water at 340°F. Each pump is driven by a 2500 hp, 3600 rpm motor.

Two primary boiler-feed or tank pumps were also supplied. These have a capacity of 1275 gpm, a discharge pressure of 700 psi, a suction pressure of 50 ft. and handle 262°F. water.

The 700 psi suction pressure of the boiler-feed pumps was selected so that the boiler-feed units from an existing section of the plant could be used as spare tank pumps. The new boiler-feed pumps have forged-steel, barrel-type casings. They were specially built for Twin Branch Station but the fundamental I-R design had been proven in other boiler-feed plants and in the refining industry.

Twin Branch Station has now been successfully operating for two years. Result: More power to beat the Axis.

Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York, N. Y.

Ingersoll-Rand

10-316

CENTRIFUGAL PUMPS • CONDENSERS • COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • OIL AND GAS ENGINES

which it is made are operated for the Government by the Monsanto Chemical Company and the Carbide & Carbon Chemical Company, respectively, and are the first of their kind to go into production in this country. The rubber and the tire itself were manufactured by Goodyear, the former in a Government-owned plant and the latter in one of the company's own establishments. The historic tire is of the size required by U.S. Army "jeeps," and is being examined in the accompanying picture by E.J. Thomas, president of The Goodyear Tire & Rubber Company.

Konag Castor Cleaner is described by its producer, the National Graphite Company, Inc., as a safe and economical material for degreasing gears, parts, metal surfaces, industrial machinery and motors, painted walls, and concrete floors. It is mixed preferably with hot water and may be applied by a bristle brush, immersion, or by air spray. The material is said to dissolve the grease with a solvent rather than a caustic action, to be noninflammable, and harmless to the skin.

The dome-shaped structure that made its appearance in 1942 as an answer to low-cost homes for war workers is finding a third application. Last year, some of them were built in California to serve as bomb shelters, and now others have been constructed for the storage of grain. Each of the latter has a maximum diameter of 29 feet, a maximum height of 13½ feet, and has a capacity of 200 tons. They are quickly erected by inflating a fabric balloon with compressed air and covering it with chicken wire and two coats of concrete applied with air under pressure. A 3-foot square opening is left at the top for loading and unloading. The bins are verminproof and were resorted to because of a shortage of burlap bags.

Aluminum and aluminum alloys in cast, forged, and wrought form can be given increased service life by plating them with hard chromium much the same as steel, according to a recent announcement by the Technical Process Division of the Colonial Alloys Company. It is claimed that platings up to 0.05 inch have been applied without hydrogen embrittlement, crazing, and lifting, and that adhesion, as well as fatigue and thermal resistance, is high. The method involves a preparatory dip of the metal into an alkaline solution which can be obtained by war contractors from the company.

So that attempts made by unauthorized persons to sabotage fire extinguishers can be detected at once, the American-La-France-Foamite Corporation has introduced a so-called Tampless Case. It is made of tough cardboard stock closed by a gummed paper strip that can be broken open by a quick pull on a sealed string. The folding carton gives concise fire-fighting instructions and can be resealed after the extinguisher has been used and recharged.

What is claimed to be a revolutionary method of making steel gears was announced at the national meeting of the American Society of Tool Engineers held recently in Milwaukee, Wis., for the purpose of reviewing new developments and simplified practices designed to aid the war effort. The process eliminates all machining operations. The gears are forged or coined, complete with teeth, on presses, and are claimed to be accurate within a thousandth of an inch even after heat-treating. Pinion gears for military vehicles are already being turned out in this way.

Through a plan announced by Walter Geist, president of Allis-Chalmers, Milwaukee, Wis., it is possible to save in a year some 250,000 pounds of rubber—an amount equal to the annual yield of 25,000 trees. Mr. Geist is the inventor of the multiple V-belt drive, and what he now proposes is that all new installations be made with shorter center distances and larger sheaves. The suggestion is in line with the present trend in V-belt drives and is explained in detail in a recent issue of *Texrope Topics* published by the company and available upon request.

Head and eye protection are afforded by a Skullgard-Eyeshield offered by Mine Safety Appliances Company. The shield, of plastic, is nonfogging and hinged so that it can be positioned by a slight movement of the hand in front of the eyes or flat

against the brim of the hat when not required. Worn either way, it is said to remain firmly in place. The shield may be obtained in combination with any of the company's Skullgards or Comfo Caps, or separately for attachment to headgear of this type already in service.

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